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THE OUTLOOK FOR PSYCHOLOGY[1]

I WISH to call your attention to certain features of the situation in psychology at present, pointing up, so far as I can, the indications for the future. My summary and my prediction can not be 100 per cent. accurate—perhaps not 75 per cent. accurate. I believe, however, that it is useful to pause in our laboratory work occasionally, and, seated in our armchairs if you please, review the results of our endeavor. I shall emphasize the laboratory, its methods, training and products, because the laboratory is the center of true psychological activities, and nothing which is not founded on the laboratory in the fullest degree possible is worthy of scientific consideration in our field. field.

I must emphasize the fact that the laboratory method has justified itself under difficulties during the last twenty years. There is always dissatisfaction with the laboratory method. In the first place, it is "academic." But partly through the results of psychologists, and partly through the achievement of other "academic" men, this term has ceased to be an insult, and is a badge of merit and accomplishment. Let us call the laboratory method "academic"; one of the most striking features of the last two decades is the ephemeral life of movements claiming to be scientific but attempting to get away from a sound academic foundation.

In the second place, the laboratory method is slow. Men outside are impatient, and want quick results. They can not wait for the results of the tedious scientist, pottering in his laboratory. We must be *practical.*

Well, I could point out the fates of some of these practical movements. They are gorgeous while they last, but not beautiful when they burst. They are great opportunities for the charlatan and the sciolist, but unfortunately they have diverted the energies of many really able men.

The laboratory method receives its justification when these "practical" booms burst, having hastened to application when there was nothing to apply, and the shattered legions come limping back to inquire

[1] Address of the retiring vice-chairman before Section I, of the American Association for the Advancement of Science, at the New York meeting, December 29, 1928.

whether the laboratory has yet anything for them to apply in a new campaign. The laboratory method *is* slow, and the laboratory man is exasperating; but somehow, their products have to be awaited. I could draw a striking parallel with medical programs in this regard, but it is too obvious to need elaboration.

A third complaint against the laboratory man is that he is not only aggravatingly slow, but that he is pig-headed, in respect to practical problems. He does not apply himself closely enough to those matters for which an immediate use can be found.

We want the psychologist to find out how to reduce crime, and the exasperating fellow spends his time month after month in putting rats through a maze or in chronicling the rodents' amorous behavior. We want the psychologist to find out the constitutional mental differences between whites and negroes, and he merely amuses himself and wastes university money finding out whether three-year-old children are materially concerned as to whether they wet their beds or not. It would seem imperative that the psychologist should devise means of helping the neurotic person to gain control of himself, and to save him from the exploitation of the commercial practitioner. But the wretch just loafs around his laboratory determining whether a deaf and dumb victim wriggles his fingers or not while he thinks. And so on, and on. We all know these complaints. We know also that from time to time some half-baked psychologist swells up with a practical, non-academic, idea which is going to solve some vast problem, and then spatters the rest of us disagreeably when he blows up.

Unfortunately, where the psychologists have been unwilling to be charlatanistic, others have not been so reluctant. A man may be a charlatan, although he has high-sounding principles, if he is ignorant. He may, on the other hand, not be ignorant, and still be a charlatan. I don't for a moment suppose that all laboratory men are moral, but it is still hard for them to be charlatans.

There is no doubt that we are remiss in not making greater efforts to develop the field of abnormal psychology. I am not unaware of the work of Lyman Wells, Bridges, Franz, and certain others. But on the whole, we have left the field to the psychiatrists, and they, leaving their field of the care of the mentally diseased, have moved boldly into the field of abnormal psychology. But, unfortunately, the psychiatrists have been little interested in acquiring either psychological knowledge or psychological technique. Hence we have a rampant development of theories and nostrums. Out of this has grown the exploitation of mental hygiene, which has already begun to have an unpleasant odor, as must any extensive attempt to apply what none of the appliers knows. There is probably no expanse of fiction as rich in imaginative products as is the mass of material being put before the public as mental hygiene. For this the psychologists must shoulder some of the responsibility, for it is evident that the situation can not be cleared up until laboratory psychologists apply laboratory methods and psychological principles to research in this field. The extension of our work in this direction is not impossible; and although there are many psychiatrists who fear our entry, and oppose it where it seems threatened, there are plenty of sound psychiatrists who are ready to cooperate with us, and who beg us to begin. Right now, the need is for training men for this work, and for providing research jobs for them when they are ready to work. The universities will find it very difficult to do this, until the way has been broken. Some financial assistance from outside the universities is absolutely essential. The adequate ways of applying this are not far to seek.

It is charged, not only against laboratory men but against academic ones in general, that they have not broad human outlooks, or practical abilities. It is true that we have a lot of laboratory lizards, impractical men, who are nevertheless very valuable. But against our group in general this charge has ceased to be even an engaging slander. There is plenty of proof since 1917 that the outlook of the academic man is second to none in breadth; and that if he succeeds academically he has practical ability that he could capitalize more abundantly in business. Even the occasional laboratory man who hasn't a broad outlook is that way not because he is a laboratory man, but because he is just the limited kind of fellow.

In short: the laboratory method has justified itself in spite of great obstacles, in psychology as elsewhere. The mental test movement which made its bid for the solution of all mental problems by a cheap and simple method, short-circuiting the laborious laboratory method, has suffered notable changes. The points which were clear to all of the laboratory men fifteen years ago are now painfully apparent to those serious psychologists who were for the time dazzled, and the others are hastily preparing alibis and seeking cover. The astonishing doctrine that intelligence tests measure mental capacities directly, once broadcasted from centers of authority, is now heard only in the echoes from the more remote places, and mental testers are beginning to understand that only acquisitions are measured. It is true, some workers are still struggling with the attempt to determine whether intelligence, in general, remains constant

from year to year, using in their endeavors age-scales which have been standardized explicitly to prevent their giving such information. But, on the whole, the workers in this field are slowly being educated to an understanding of their materials and an evaluation of their results. The efforts of the laboratory men in this educational work, and their protests against the highly lucrative exploitation of the last ten years are bearing fruit.

Another great movement was spectacular because it occupied a field in which the laboratory has not been ready to make practical contributions. While it is to the lasting credit of laboratories now that they have been unwilling to rush into the field with nostrums, the field has yawned, and it has been filled —temporarily, but with great financial profits. I am referring to psychoanalysis, of course.

The clean-up job resulting from the psychoanalytic movement falls to the psychologist, whether he wants it or not. I speak not alone of the rehabilitation of patients psychoanalyzed until their funds are exhausted or until their symptoms become too serious to play with. I speak of still graver results of the popularization of psychoanalytic speculation.

Although the progress of psychoanalysis has been marked by the development of glittering hypotheses, stated as facts; the abandonment of these; and the substitution of still others; the course of psychoanalysis can not be treated simply as the zigzag path of an inebriate, marked by a series of empty flasks. The hypotheses, abandoned or not, filter down to popular level, and their origin, frequently unrecognized, produce results which are sometimes appalling.

Although the main psychoanalytic movement has burst, one of its accessory bags is still inflated, and curiously enough has fascinated a few laboratory men who ought to know better. For at least three thousand years there has been the illusion that if we could only *classify* men, great social problems would thereby be solved. And so the sheep and the goats have been classified under various more pedantic headings and subheadings. Now the terms are *introvert* and *extravert*, and we have even laboratory methods being devised to sort out the woolly animals from the hairy ones. A survey of this little inebriation episode in the case of the laboratory is most diverting, but not timely here. This movement is already sharpening its knife for the operation of hari-kari—which unfortunately will be carried out on our doorstep. The great validity of the laboratory method lies in the fact that it not only survives these vicissitudes, but looms up more solid, more necessary, more vital and more worthy of respect than ever. I am no fanatic for pure science. I realize that the ultimate justification of any science is in its application. But I must call upon you to rejoice with me that the absolute necessity of pure science is receiving its recognition even in fields where it has been most sorely beset.

It behooves, then, the laboratory men, having upon their shoulders the responsibility not only for the future of psychology but also for the welfare of society, it behooves them, I say, to consider with due earnestness and solemnity the actual situation in laboratory psychology. I do not for the moment suppose that all psychological problems will be solved in the laboratory; but let us admit that the laboratory is the foundation, and that foundation must be conserved and extended. The total group of laboratory men represent many tendencies and preoccupations. Our differences are interesting, and we love them, but it is imperative that we should at times forget these, and consider our common interests and common duties, which I submit are far greater.

The situation in laboratory psychology is not satisfactory. It is not efficient. It is not safe. It is depressing. In the first place, in response to the feverish demands after the war, we have trained too many psychologists, or partly trained them, and there is an excess of teaching and deficiency of research. I am well aware of the fact that the output of research publication has increased, and that in spite of the establishment of new journals, all avenues of publication are congested and an enlargement of these avenues is needed; but whether the volume of research that will be of importance a few years after it has appeared has greatly increased, is another matter into which I shall not at the moment inquire. At any rate, the energies of some of our best young men are engrossed in teaching, and it is a question whether the teaching is worth while in the case of 70 per cent. of the pupils. Leaving out of account the matter of general psychology, which is given to hordes of uninterested youths, the courses in applied psychology from the text-books, and various other sorts of alleged psychology—the laboratory course should be given consideration. I believe that most of the laboratory work given undergraduates is wasted. It is not intense enough to prepare them for research, and as a cultural effort is a total loss. Most of the students subjected to it come out with a scorn for psychology as a trivial subject; nor do I believe that any laboratory work can be given large classes of students which is not a waste of time or worse. I believe psychology would benefit greatly by drastic reduction of laboratory students; a reduction to those who go deeply enough into it to get something definite, and to numbers small enough to make that possible.

As concerns our graduate students, the problem is again a serious one. It is well known that most of them, after doing research for the Ph.D., die on their jobs. They take teaching positions and do no more research. It has been said in this connection that most of these men are not really research men; that they have done research under artificial conditions, working out ideas supplied by the director, and under the personal stimulation of the director, automatically ceasing operation when the extraneous ideas and stimuli are not supplied. This is true in some cases. In other cases it appears that the situation is different. The graduate student, especially in the last year before the doctorate, is in a simple situation. He can give his time to research without distraction. Then he tackles a teaching job, and must put a large part of his time and energy for a year or two into organizing courses; into organizing too many courses. The stimulus to research is lessened; the situation is a new one. If he has held a post-doctorate fellowship, prolonging the time to the critical change, I believe the situation is still more difficult. By the time the teaching is routinized he has forgotten how to do research under difficulties.

This situation has been recognized, and occasionally attempts have been made to meet it by relieving of teaching a man who has had research ability in the past, in order that he may do research. What is the result? He does nothing. Hence college administrators are hard boiled. No one will be relieved of his teaching load unless he will prove that he will do research while carrying the normal load. I believe this is as it should be. What are we doing to encourage the younger men to initiate research along with their teaching? Nothing, except to talk about it, and to stimulate piffling types of investigation requiring little time, energy and development. Is there anything that could be done effectively? I believe there is. Two things are necessary: (1) to set up a definite facilitation of the utilizing of spare time in research of a major character; (2) to hold out definite types of assistance to those who succeed in starting research under those conditions. How shall this be done? I have a suggestion to make a little later.

I come now to one of the larger evils in laboratory psychology: the general instability and impermanence of departments. In theory, and officially, there are a number of departments of psychology in the United States which have had a considerable period of life and growth. To measure them from the official data of establishment of departments is not quite satisfactory from the point of view of laboratory psychology, since some institutions had no laboratories until some years after the departments were established, and in other cases there were laboratories for psychology before there were psychology departments. If we estimate the ages from the dates of actual laboratory installation, we have a fairly impressive list. Really, however, the ages are merely chronological and the continuities are sadly lacking. The characteristic record is of the building up of the staff, the accumulation of apparatus, the development of the body of problems, and then the wreck of the organization with the commencing of a new department into which the first group of problems scarcely enters, and for which a new accumulation of apparatus and the development of new types of technique are necessary. There is, in fact, hardly a laboratory organization in the United States as much as ten years old.

Now, I am not saying that conditions are better in other sciences. I am merely complaining that the conditions in psychology, which are highly unsatisfactory, have contributed to the production of isolated and fragmentary research, and to the retardation of progress in the solution of fundamental problems. Obviously, the causes of these conditions are largely beyond our control, lying primarily in the short-sighted policies of university administrators in general. The rapid development of laboratories, leading to the frequent shifting of personnel, is partly responsible; but this shifting would not be possible if there were any fundamental stability in the older places. Instead of the developments taking place in the institutions where the best men are, they take place in new institutions in order to attract these men away from their establishments. One of the signs of inefficiency due, I believe, in part, to this instability and lack of progressive utilization of resources, is in the fact that the destruction of files of our journals would not be a great loss. The loss would be principally in some of the newer developments of psychology, such as animal behavior. Certainly an impartial censoring of what is contained in the volumes would be an unmixed blessing.

How this instability may be reduced is a perplexing question. The establishment of institutes affiliated with universities, but under relative autonomous control, may help, and is an experiment worth while, but it introduces new and serious evils, and I do not believe it will be a panacea. In the meantime, it is most expedient to consider whether there is a possibility of increasing the stability of our laboratory work as a whole in spite of the instability of departments. For it is increasingly evident that there are fundamental problems of pure science which must be solved for the benefit of other problems which are

rooted in them, and that these problems can not be solved in a short time, or by the solitary efforts of one or two men. Furthermore, some of these problems require expensive installations of a magnitude which make the provision wasteful and vicious unless their use can be extended over a long period of time in the hands of a series of competent persons interested in these problems.

Let me return now to one of my main points of dissatisfaction with laboratory work and suggest a remedy. The salvaging of researchers and the stimulation of better research may, I think, be forwarded very much if two provisions can be made: (1) for summer research fellowships, and (2) for the aid of going research at critical points. Let me elaborate the first suggestion somewhat.

The young instructor, struggling to organize his teaching work, theoretically has his summer free. Practically, he is forced by financial considerations to seek a summer-school job, or else some non-academic type of employment, in order to support his family. If he teaches in a summer school, he labors with a group of tired-out schoolma'ams, case-hardened superintendents, college students of inferior grade who have flunked their courses in regular session, and an assortment of high-school sheiks and flappers. He accomplishes nothing of importance, and he comes back to his fall work fatigued and unprepared for it. Yet he has few alternatives. It is all right to say that university salaries should be more adequate, so that instructors would be able to spend their summers more profitably; but university salaries are not adequate for younger men, and they will not be. Moreover, I am not certain that more adequate salaries would turn the trick. The incentive to a better scale of living or to a trip to Europe would be too great. Now, I am not belittling either of these goods. But sacrifice must be made, and it is usually necessary to establish conditions such that the proper sacrifice will be chosen.

If a young instructor were offered the alternative of a summer-school job at $600 or a research fellowship at $450, he would choose the latter, or else show that he had not the stuff in him. In the summer, if not distracted, he could start research and thus get back into the harness. During his academic year, even, he can start research if he can see the possibility of effectuating it in the summer. The plan is well worth trying, and does not require any vast amount of funds. The objection will be raised that there are few places where summer research can be carried on. Few institutions of high rank maintain a summer quarter, and from the institutions which maintain the upper summer schools, the good men on the staff flee during the summer as from the pestilence. A psychological Woods Hole is not possible. Psychology is not that kind of a subject. Moreover, although Woods Hole and La Jolla and Friday Harbor are doing for the young biologists something of that which I am proposing to do for psychologists by summer research fellowships, I am not completely convinced that it is the most satisfactory solution of the problem even for the biologists, and I suspect that if the scheme I propose were established for psychology, not only the physical sciences but even biology would follow in our wake.

Let us grant that few places at present are prepared to take summer researchers. This is true, and there would be few fellowships at first. But the stimulus thus furnished to other institutions would be great, and I believe that there would be an effort on the part of the universities to offer attractions to summer researchers. There might even be a reduction in the summer schools of the present type, and this would be a great blessing in itself.

In this connection, I should like to point out that the national laboratory I have proposed would be of material advantage. A certain number of summer workers could be provided for on certain topics. This would, however, not fill the whole bill, or even a large part of it.

I may point out, finally, that this summer research fellowship plan is not a mere extension of the present pre-doctoral and post-doctoral fellowship experiment, but is rather something designed to offset the evil effects of these.

Now as for funds for the aiding of research. This is a ticklish subject. In the first place, the administration of such funds offers a serious problem. The selection of really worthy research and the aiding of it in a way which shall be effective, and which will not relieve universities of their responsibilities, is apparently too difficult a job. Two years ago I should have said that there is no agency competent to do this. The National Research Council seems at first incompetent because of the constant flux of the divisions, but it is now impressed upon me that the capacities of the council have not been fully utilized. A changing division may have permanent committees, and a permanent committee can do this very thing, inefficiently at first, but with a steadily increasing efficiency. Certain of our committees have in the last few years demonstrated the fact that they can fulfil functions of this type.

Certain principles of award are capable of being outlined. No grant must be made except to "going" research. Projects are a snare and a delusion. The man whose research is to be aided must have shown that he has a vital problem, that the problem is capable of solution in his hands and that he has the guts

to see it through. Again, it is not a question of financing men. Financing men sounds well but doesn't get results. Research, not projects; work, not men—these are worth assisting. This plan would establish a situation quite different from the present one, under which it is easier for the man to get funds for something he proposes to do than for something he is doing. In fact, that he has research actually going now counts against him. Hence, instead of furnishing a stimulus to the best men to get research started on their own, discouragement is produced. Men say: "I would like to do research if I could find the time, or if I could get assistance." What we must show them is that the man who can get research started with no time and no assistance will be helped to finish it. The importance of this stimulation I believe to be very great.

As regards the effects on university budgets, I believe the plan can be so handled as to stimulate the universities to more generous provisions, instead of weakening their efforts. Aside from the fact that university cooperation would be demanded in awards, there is the fact that the difficulty in university provision is in regard to elasticity. No department needs the funds for vital research in one year that it needs in another. Yet, departmental budgets can not be very elastic, and the natural tendency is toward the minimal, not the maximal provision. More generous provision in many cases means actual waste and the production of rotten research. Universities themselves recognize this, and attempts are made to provide elasticity through the setting up of general university research funds to be applied as needed each year. This scheme is useful but has painful drawbacks. Politics is by no means absent from universities, and departments can often enforce claims to consideration against other departments. No one in a university except the psychologist knows whether a certain psychological project for research is valuable or not. Hence, the tendency to dole out in accordance with the importunities, and to consider whether the department has been getting its share of the booty or not. For its effect on the administration of university funds an expert national committee is much needed; but such a committee would have no standing with institutions unless it, itself, had some funds to administer.

Let me give an example. The situation of the psychogalvanic experiments, so-called, is a scandal, and a stench to the nostrils. In a number of universities the galvanometric method is being used, but is apparently getting nowhere. Individual experimenters publish results which can not be duplicated by other experimenters. Yet a number of our most able young men are working in this field. The trouble is not in lack of physical technique, for these same experimenters have shown their ability to take galvanometers which other departments were unable to operate, set them up, and get them going in excellent style. I think we may readily discern that the trouble lies in the complicated psychological conditions, and in the lack of development of psychological technique applicable to these conditions, and which can be made a matter of accurate record. At present it is impossible to ascertain what any of the experimenters really did obtain. Their results, no doubt, are valid for the conditions of their work, but what were the conditions? Nobody knows. I am speaking here of the careful workers, oriented in the history of the method and in the techniques of preceding investigators, in so far as it is possible to know what these preceding workers did. I am not speaking of the hasty and ignorant persons who have discovered wonderful things by appalling technique.

The committee on research on emotions in the Division of Anthropology and Psychology of the National Research Council thought it possible to forward research in this vexed field by providing for a three-year research in the hands of one man. No funds were obtained for the research. Although I was a member of the committee, I am now convinced that this abortion was not unfortunate. If the research had been financed, the results would have been merely one more set of data which no one else would have accepted.

We have among us six or eight young men who are as well versed in the galvanometric technique as is possible under present circumstances. What are the possibilities of pooling their abilities and training? Not any, under present conditions. What university could undertake the work of cooperation and correlation? None, so far as I know. What would be the cost of an installation competent to provide for the various aspects of the problems which, it is plain, must be taken care of during a period of twenty years? My present estimate is $100,000, assuming that a suitable site and building were available. There is, however, no such edifice at present. Spending such sums of money under present conditions would be mere folly. Suppose you were to put the installation in Siwash University, which may at the present time have a laboratory director interested and competent in problems of this type. In five years' time, the department at Siwash might be remodeled, the director dead or gone to some better place, and the new director trained in and interested only in the study of the putative ancestry of emotionally unstable children.

The installation necessary for the psychogalvanic work is also useful for other lines of work, after the

psychogalvanic cycle shall be completed, and to a certain extent while it is being carried on. The galvanometers will be required for fundamental attacks on problems such as those of speech and thinking; and various accessory apparatus will also be essential or accessory for certain other problems of a lengthy and fundamental nature. What I really am proposing, therefore, is a national psychological laboratory, similar in some of its functions to the Bureau of Standards, but not under federal control. Such a laboratory can be under relatively permanent direction and can undertake programs of research too lengthy, too expensive and too complicated for other institutions. In such a laboratory truly cooperative results of the highest value can be obtained. Men working in other laboratories on details of the problems undertaken in the national laboratory could make arrangements to transfer their work there during a year's leave of absence, or in summers. Work done here can be subjected to criticism while in progress, instead of afterwards, and the cooperative method can insure greater certainty as to conditions. Such a national laboratory, I believe, could be of really inestimable advantage to psychology, not only because of its availability for the solution of problems unwieldy elsewhere, but because through it standards of research may be elevated.

The day of the isolated experimenter and of fragmentary problems is passing. Unless we find means of shaping our problems into coherent plans of larger unity; unless we find means of carrying out vital research and postponing the merely interesting; unless we can pool our constructive and critical abilities, we shall be out of step with the advance of scientific method.

Another of the troubles of laboratory psychology, not its last, but the last I will mention, concerns publication of research results. Publication at present is in an unsatisfactory position. Costs to authors for monographs are too high. Subscription prices to journals are too high. There are not enough journals, yet there are more than we can support. Under such conditions the tendency is to suppress data which might be valuable, and to publish conclusions which are usually worthless. Stuff is published which ought to be burned, and research which ought to be published sleeps in pigeonholes. Publication is on an unsatisfactory basis both commercially and scientifically. Publications of a sound type should be more generally supported by the company of psychologists individually. They can not be so supported until prices are reduced, and prices can not be reduced until wider support is given. Here we have the old problem of the irresistible force and the immovable body.

The problem of abstracting is closely allied with that of original publication. It is openly admitted that the present abstracting experiments in psychology and biology may not give the results which were hoped. Nor can we reasonably expect satisfactory results on the basis of amateur work. Unless we have a group of well-paid abstractors, with at least doctoral training in the fields they cover and giving their whole time to the work, the abstracting business will be a disappointment.

Now I am fully aware that my proposals are open to many objections. In the first place, they are dangerous. They seem to tend toward centralization of power which can dictate to institutions and individuals. Centralization, maybe; but dictation—fiddlesticks! On the contrary, the committees which should administer such trusts would be extremely unpopular, and would do as much good by stirring up attempts to do without their aid as they would through their aid. The administration would be incompetent, certainly; but it would not dare be as incompetent as our departments are. The greatest objection of all is this—the schemes are financially Utopian. There isn't that much money. Well, money is being spent at present on far less definite and less vital projects. We may not be able to get money, but if we see clearly the needs, and the benefits that would accrue from these plans, or from still better plans which you may suggest, then we are slackers in our duties if we do not present our case. That is all that I am interested in at the present moment.

Knight Dunlap

The Johns Hopkins University

FREDERICK CHEEVER SHATTUCK[1]

A shrewd and kindly judge of human nature, a whimsically humorous commentator on men and affairs, a wise physician rich in the learning derived from large experience, an impressive and stimulating clinical teacher, a far-sighted, enterprising and generous supporter of important new developments in medicine—these are some of the lasting impressions of Dr. Shattuck which lie deep in the memory of his colleagues in the Harvard Medical School.

His association with the Medical School was long and distinguished. Six years after his graduation in 1873, he was appointed clinical instructor in auscultation and percussion, and as instructor in those subjects and later in theory and practice he continued for nine years, until 1888. He then became Jackson professor of clinical medicine, a title which he honored

[1] Minute placed on the records of the Faculty of Medicine, Harvard University, at the meeting of February 1, 1929.

through twenty-four years of illustrious service. His amphitheater lectures and demonstrations at the Massachusetts General Hospital were model exercises, characterized by careful selection of instructive cases and by clear and definite emphasis on the most significant features in them—an emphasis reinforced by his own very wide acquaintance with the manifestations of disease. A playful humor which kept both the patients and the students in good spirits pervaded his informal clinical instruction. Frequently an apt quotation from the Bible or a pertinent literary reference left in the minds of the students an indelible record of the main points to be remembered. Dr. Shattuck was a great clinical teacher.

For more than a decade, from 1898 to 1909, he was a member of the important faculty committee on the course of study. His interest in efficient instruction led him to recognize not only the defects of the rotating service in the hospital, where each visiting physician was on duty only four months in the year, but also the possibilities of duplication and omission because of the existence of two separate departments in the Medical School, Clinical Medicine and the Theory and Practice of Physic, each teaching independently. Convinced that continuity of policy both in the hospital and in the Medical School was essential for medical progress and for reliable medical instruction, he heartily cooperated in a plan which gradually evolved into continuous service of a single directing head at the hospital and into one department of medicine in the Medical School. His foresight made possible the present satisfactory arrangements between the Medical School and the several hospitals in Boston where Harvard students are taught.

When in his sixty-fifth year Dr. Shattuck resigned the Jackson professorship, he had served the Medical School for a third of a century. He might reasonably have looked forward to years of comfortable retirement. That course did not suit his temper, however, and although a professor emeritus he was destined to continue in service for sixteen years more. During this later period he made in some respects his most distinctive contributions to the development of medical activities.

In 1913 it was proposed that a department of tropical medicine be established for an experimental period of five years, during which the desirability of its permanent continuance should be determined. With indefatigable industry Dr. Shattuck immediately undertook to raise the funds necessary for the favorable outcome of the venture. His good judgment and his wisdom were so well known in the community and his advice had been so often followed that his efforts were soon successful. Before the trial period was ended he himself generously endowed the chair of tropical medicine and thereby provided for its permanence. His interest in the cultivation of this field of medical undertaking, as evidenced by constant support and encouragement, continued to the end of his life.

The help which might be given by medical research to the industries of New England appealed to Dr. Shattuck's imagination, and in 1916 he collected a fund to be used during five years to demonstrate the usefulness of medicine in promoting the health of working people. A committee on industrial hygiene was created to administer the fund, with Dr. Shattuck as chairman. He concerned himself vigorously with the enterprise and was especially active in devising ways to render the skill and insight of medical investigators available for the solving of problems of industrial hazards. The valuable results of this experiment in the application of medicine to community welfare had large influence in the establishment of the Harvard School of Public Health.

Towards his intimate friends Dr. Shattuck showed a warm and devoted affection. It was typical of him that he paid his tribute to them in ways which both honored them and served noble ends. Out of a high regard for Dean Edsall he recently founded in his name a handsomely large revolving loan fund which will permanently provide financial assistance for students who otherwise could not obtain here a medical education. The names of two others, outstanding members of the medical profession in Massachusetts, will also be known to untold future generations because of his whole-hearted admiration. In 1910 he established the Henry Pickering Walcott Fellowship in Clinical Medicine, in 1913 the Arthur Tracy Cabot Fellowship in Surgery. Both fellowships have already proved of inestimable worth in providing opportunities for research by able young investigators.

Dr. Shattuck served the Harvard Medical School loyally for almost fifty years. As a teacher he insisted that his students should acquire sound knowledge and should adhere to high standards of practice. As a physician he had a rare insight into the nature of both the patient and the disease, a keen critical judgment and a skill in bringing comfort and cheer to the sick that was inimitably a display of his own genius. Courtesy, simplicity and directness of thought and speech, a penetrating humor, and utter frankness and sincerity stood forth as his most striking qualities. When with advancing years he might have been expected to grow fixed and reactionary, he showed the freshness and enthusiasm of youth; he seized eagerly upon new opportunities for promoting the progress of medicine and helped to bring them triumphantly to successful issues. By good fortune he was spared to us until nearly his eighty-second year, and when

January 11 he passed away he left a memory of human character and of unselfish devotion to professional ideals which we who were privileged to know him shall long cherish.

Walter B. Cannon,
Henry A. Christian,
Richard P. Strong,
Committee

SCIENTIFIC EVENTS

BRITISH SOLAR ECLIPSE EXPEDITIONS[1]

There will be a total eclipse of the sun on May 9, at 6 o'clock in the morning by Greenwich time, invisible in any phase in England, but to be seen as a total eclipse from a track that lies in the Indian Ocean south of Madagascar, in the west, and crosses Sumatra, the Malay States, Siam, Cambodia and the Philippines, in the east. In these eastern regions the sun will be high in the sky and the duration of totality on the central line will be about five minutes. This long duration justifies the effort of making much preparation and a long journey for observation of the eclipse, and at the end of next week expeditions made up of observers from Greenwich and Cambridge will set out for that purpose.

Dr. John Jackson, chief assistant of the Royal Observatory, and Dr. Carroll, assistant director of the Solar Physics Observatory at Cambridge, will proceed to Alor Star, in Kedah, in the Malay Peninsula, where they will be joined later by Dr. Aston, of Cambridge. Professor F. J. M. Stratton, lately called to the chair of astrophysics in the University of Cambridge, who was the leader of an expedition to Sumatra to observe the solar eclipse of January 14, 1926, when the duration was about four minutes, will, accompanied by Mr. P. J. Melotte, of the Royal Observatory, Greenwich, occupy a station at Pattani, on the east coast of southern Siam, where they hope to have the help of Dr. Royds, director of the Observatory at Kodaikanal, southern India, and Colonel Waley Cohen, who took part with Professor Stratton in the eclipse of 1926.

At both places the experiment will be made to detect the Einstein effect of the bending of rays of light by the attraction of a massive body that they pass. In other words, the endeavor is made to find whether the relative positions of the individuals of a group of stars are precisely the same when the sun lies among them as when it does not, since by theory the supposed Einstein attraction is not the same for all of them. The answer to the question is looked for by photographing the stars that may be seen round the sun when the sky is darkened by eclipse, and comparing the result with a photograph taken some months later when they are seen in the night sky. To do this Dr. Jackson will take with him a telescope of comparatively small diameter, 7-inch, but of 21 feet focal length, to be used with a cœlostat, or rotating mirror, that will feed it with light from the celestial scene, the telescope itself remaining horizontal and stationary during the exposure of the plates.

At Pattani the instrument to be used for the same purpose is the Greenwich Astrographic telescope of 13-inch aperture and 11 feet focal length on an ordinary equatorial mounting. It is necessary in measuring the photographs when taken that their linear scale shall be accurately known, and to ensure this a program has been arranged for photographing not only the stars immediately round the eclipsed sun, but also a field a little distance away alternately, and several times during the precious five minutes—a task which will necessitate deft handling by the operators.

The combined program includes other tasks no less important, dealing with problems in solar physics—a study of the relative intensities of the lines H and K and the triplet X of ionized calcium in the infra-red, to test Professor Milne's theory of the calcium chromosphere; spectrophotometry of the chromosphere with a four-prism quartz spectrograph, formerly the property of the late Colonel Grove-Hills; determination of wave-lengths of lines in the corona and of its rotation and of the state of polarization of its light. It need scarcely be said that direct photographs of the corona with varying length of exposure and on varying scale will be taken if the weather permits, to continue the comparatively long series of these records that already exists.

[1] From the London *Times*.

THE FORESTRY PRIZE

A friend of forestry, who wishes to remain anonymous, has given the Society of American Foresters (headquarters, Lenox Building, Washington, D. C.) $1,250 to be awarded as prizes of $1,000 and $250 for the best essays describing the present forestry situation in the United States and proposing a nation-wide remedy for its solution. The purpose of the donor is to stimulate the study of the national problem of forestry and to bring out constructive suggestions for meeting it in an effective way.

The conditions of the prize are as follows:

(1) Essays submitted in the contest shall cover: *First,* the actual forestry situation in the United States to-day; *second,* a nation-wide remedy which (a) will, if applied, solve the problem of a permanent and sufficient supply of forest products and secure other benefits of forests essen-

tial to the public welfare; (b) will be applicable in actual practice, and (c) can be applied in time to meet the nation's needs. The essays must be based not on hypothetical assumptions, but on the actual situation in the United States to-day.

(2) The essays must be typed and must not exceed 3,000 words, exclusive of a summary of conclusions which should be presented at the beginning of the paper.

(3) The contest is open to any individual who desires to compete.

(4) Essays should not be signed by the author's real name but by a pseudonym. This pseudonym should be placed on the outside of an envelope containing the author's real name and transmitted with the essay.

(5) The winning essays shall be published in the *Journal of Forestry*. The Committee of Award shall have the right to select from the other essays those which it deems worthy of publication and they will be published also in the *Journal of Forestry*. The remainder of the essays will be returned to the authors if they request their return and provide postage.

(6) The Committee of Award reserves the right to withhold the prize providing no essays which are in its judgment worthy of the award are received.

(7) All essays submitted in the contest should be forwarded to either of the two members of the Committee of Award, namely, S. T. Dana, School of Forestry and Conservation, University of Michigan, Ann Arbor, and Raphael Zon, Lake States Forest Experiment Station, University Farm, St. Paul, Minnesota, in time to reach them not later than September 30. The awards will be announced at the annual meeting of the Society of American Foresters in December, 1929.

P. G. Redington,
President of the Society of American Foresters

WALTER RATHBONE BACON SCHOLARSHIP

Under the terms of the will of the late Virginia Purdy Bacon, of New York, the Smithsonian Institution some years since was bequeathed the sum of $50,000 to establish a traveling scholarship as a memorial to her husband, Walter Rathbone Bacon, for the study of the fauna of countries other than the United States. The amount available is the interest on the capital invested (about $3,000 a year), the incumbent to hold the scholarship not less than two years.

The institution has decided to offer an additional scholarship in 1929.

Applications for this scholarship, addressed to the secretary of the Smithsonian Institution, should be submitted not later than April 15. The application should contain a detailed plan for the proposed study, including a statement as to the faunal problems involved; the reasons why it should be undertaken; the benefits that are expected to accrue; the length of time considered necessary for the carrying out of the project; the estimated cost, and the scientific and physical qualifications of the applicant to undertake the project.

The scholarship will be awarded for a term of two years. If at the expiration of the term it is desired to extend the time, the incumbent shall make application a sufficient time in advance, accompanied by a statement as to the necessity for such extension.

All collections, photographs, records and equipment become the property of the institution.

The incumbent shall not engage in work for remuneration or receive salary from other sources than the institution or its branches during the period of occupancy of the scholarship.

C. G. Abbot,
Secretary

RESEARCH ON THE ALLOYS OF IRON

An extended research in alloys of iron is planned by the Engineering Foundation in cooperation with the American Institute of Mining and Metallurgical Engineers.

The industries, universities and technical schools, bureaus of the United States government, scientific organizations and foreign agencies will aid. Practically all industries are affected. The initial task is a critical five-year review of all available literature in English and other languages, resulting in a series of monographs and manuals, which will be published at a cost of $150,000.

Following a conference of representatives of makers and users of irons and steels, technical societies, government bureaus and universities, headed by J. V. W. Reynders, a committee on alloys of iron research has been appointed. The chairman is Dr. John Johnston, director of research and technology of the United States Steel Corporation. Other members of the committee are: F. M. Becker, president of the Union Carbide and Carbon Research Laboratories; H. W. Gillett, chief of the division of metallurgy, U. S. Bureau of Standards; James T. MacKenzie, metallurgist and chief chemist of the American Cast Iron Pipe Company; A. J. Wadhams, manager of research and development of the International Nickel Company.

Mr. Alfred D. Flinn, of the Foundation, has issued a statement in which he points out that "the future progress of the American iron and steel industry will be greatly affected by its ability to maintain a strong position in alloy irons and steels. It has taken forty or fifty years to develop the present state of the art for carbon steels through contributions from time to time by those engaged in iron and steel manufacture. The world is moving too fast to await a similar deliberate development for alloy irons and steels. The time appears opportune for cooperative research to

devoted largely to the fundamentals, leaving the individual companies to build upon this substructure their own specific technical developments." The American Institute of Mining and Metallurgical Engineers is cooperating in the development of this new project.

The second phase of the program, which, it is expected, will extend over a long period of years, will be research directed toward increasing fundamental knowledge of iron and its combinations with other substances, particularly alloys of pure iron with one r two or three or more other pure metals; also the ffects of the impurities incident to practical operaions.

For other research the foundation has appropried $10,000. At Lehigh University, Professor Brady Stoughton is investigating combinations of silicum ith iron. At the Carnegie Institute of Technology, ittsburgh, Professor V. N. Krivobok is studying mbinations of manganese with iron.

CHEMICAL EDUCATION AT THE JOHNS HOPKINS UNIVERSITY

The numerous inquiries about the chair of chemical ucation, provided by Francis P. Garvan, president the Chemical Foundation, seem to warrant a few eliminary remarks at this time. This chair has been tablished in the department of chemistry of the hns Hopkins University and has for its primary jective the promotion of chemistry through cheml education. The principal project being investited at the present time is connected with the gular chemical work of the scholastic year.

During the scholastic year, there is a program of dy in the selection and education of prospective ders in the field of chemistry. In the study to be rsued, emphasis is to be laid equally upon the ection of men to be trained and the training of n selected. In order to limit the project and, at same time, to place it upon a truly national basis, plan adopted makes ultimate provision for one lent from each of the forty-eight states. Selec- is to be made from the sophomore, junior or or classes of the colleges and universities of the pective states. The time of selection is indicated the desirability of obtaining students as soon as sible after they have had reasonable opportunity letermine the field in which they desire to special- It is, furthermore, in harmony with the present of the Johns Hopkins University, which affords student an opportunity to acquire the Ph.D. de- in a minimum of four years after the comion of the sophomore year.

he selection is accomplished through state comees which evaluate the student's complete previous lastic record and the following personal qualities ted by his instructors: health, ability to cooperate, creative ability, intellectual honesty, persistency, faculty of observation, enthusiasm, initiative, reliability, conduct, morality, scholarship.

As an assurance that men of unusual promise shall not be debarred by lack of funds, a four-year fellowship of one thousand dollars annually will be offered in each state.

Among the fellowships to be thus offered are those established by: The Eli Lilly Company, of Indianapolis, Indiana; The J. T. Baker Chemical Company, of Phillipsburg, New Jersey; The Firestone Tire and Rubber Company, of Akron, Ohio; Dr. H. A. B. Dunning, of Hynson, Westcott and Dunning, Baltimore, Maryland; Bill Raskob Foundation, Wilmington, Delaware; Kewaunee Manufacturing Company, Kewaunee, Wisconsin; Francis P. Garvan, New York, N. Y.; Brown Company, Portland, Maine; Brown Company, Berlin, New Hampshire.

In the training of these selected men, fundamental courses in mathematics, physics and English, as well as the four major branches of chemistry (inorganic, organic, physical and analytical), will be emphasized. There will be no attempt to specialize in the various applications of chemistry. The elective system of study for the student is under an advisory committee of the department.

An explorative opportunity will be offered in the teaching of chemistry and in industrial work to determine the line of work for which the student is best fitted.

Those who choose teaching as a profession will have the opportunity of taking four subjects in addition to the regular curriculum for a Ph.D. degree in chemistry. The subjects are: educational psychology, philosophy of education (or history of education), theory and practice in chemical education and comparative study of chemical development. These subjects will be presented with a view to fitting the candidate to teach in colleges or universities. The satisfactory completion of these subjects will be rewarded by a certificate, which will be given in addition to the Ph.D. degree in chemistry.

In addition to pursuing the fundamental curriculum above outlined, the students will have the opportunity of coming into personal contact with leading European and American chemists through a series of special lectures, means for which have been provided by Dr. A. R. L. Dohme, of Sharpe and Dohme, Baltimore, Maryland.

SCIENTIFIC NOTES AND NEWS

Dr. W. W. Keen, emeritus professor of surgery at the Jefferson Medical College, celebrated his ninety-second birthday on January 19. An Associated Press dispatch reports that on February 13 Dr. Keen un-

derwent an operation at the Jefferson Hospital and that his condition was reported as favorable.

A bronze bust of Mr. Herbert Hoover, by Mrs. D. W. Leys, of Yonkers, N. Y., was presented to the American Institute of Mining and Metallurgical Engineers by C. A. Fisher, of Denver, on February 19. Mr. Hoover is a past president and honorary member of the institute.

The Edison medal, awarded to Dr. William D. Coolidge for his contributions to incandescent and electric lighting and to X-rays, was presented on February 15 at the annual winter meeting of the American Institute of Electrical Engineers. Dr. Michael I. Pupin outlined the achievements of Dr. Coolidge, who then delivered an address.

The award of the Western Society of Engineers for 1929 has been conferred on Colonel Bion J. Arnold, chairman of the Board of Supervising Engineers of Chicago.

Professor P. W. Bridgman, Hollis professor of mathematics and natural philosophy at Harvard University, will deliver the Guthrie lecture for 1929 of the Physical Society of London on April 19.

Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, delivered the William H. Welch lectures at Mt. Sinai Hospital, New York, on February 1 and 4, on "Twenty-five Years of Epidemic Poliomyelitis"; and on February 6 the Nathaniel Lewis Hatfield lecture at the College of Physicians, Philadelphia, on "Epidemic and Post-vaccinal Forms of Encephalitis."

The retirement of Professor R. S. Newall from the chair of astrophysics in the University of Cambridge is being chosen as an opportunity to secure for the university a bust or a portrait. In 1889 Mr. Newall presented to the university his 25-inch refractor, then the largest in England, and, as the authorities had not the funds to meet the annual expense required in its use, Mr. Newall agreed to give his services gratuitously for five years and the five years of this arrangement have been extended to forty. Sir J. J. Thomson, at Cambridge, and Sir Frank Dyson, at the Royal Observatory at Greenwich, are treasurers of the fund.

A special number of the "University of Iowa Studies in Psychology" has been issued in honor of Dr. C. E. Seashore. The volume contains a telephotograph of Dr. Seashore as frontispiece, a complete annotated bibliography of his writings, a review of the ten volumes of Iowa Studies in Psychology, issued from his laboratory, and researches by his former students, extending in all to 223 pages. The dedication to the volume reads: "To Carl Emil Seashore, psychologist, dean of graduate study, explorer in the realm of music, man of science. In commemoration of the completion of twenty years' distinguished service to psychology and to the State of Iowa, this volume is affectionately dedicated by former students." In addition a portrait painted by Mildred W. Pelzer, of Iowa City, has been presented to Dr. Seashore by his students and will be hung at the university, and a collection of letters from former students has been assembled and presented to him.

Dr. Karl Jordan, of Tring, England, has been elected president of the International Commission on Zoological Nomenclature, to succeed the late Professor F. C. Monticelli. Professor Fillipo Silvestri, of Portico, Italy, has been elected a member of the commission.

Sir Richard Gregory was elected president of the Royal Meteorological Society at the annual general meeting in London on January 16.

Professor Henry Louis, formerly professor of mining and metallurgy at Armstrong College, Newcastle-on-Tyne, was nominated at the meeting in Balboa for election as the next president of the British Iron and Steel Institute.

M. Jean Perrin has been elected president of the French Physical Society, and M. Charles Fabry has been elected president of the Meteorological Society.

Professor D'Arcy W. Thompson, professor of natural history in the University of St. Andrews, has been elected a corresponding member of the Biological Society of Paris.

Dr. William Salant has resigned as head of the department of physiology and pharmacology of the medical department of the University of Georgia, the resignation to be effective at the expiration of the current academic session. Dr. Salant will devote himself exclusively to research at the pharmacological section of the biological laboratory, at Cold Spring Harbor, Long Island.

Nathan W. Bass has resigned as geologist with the U. S. Geological Survey to accept a position on the staff of the Pure Oil Company, with headquarters in Tulsa, Oklahoma.

Dr. G. A. Talbert and his collaborators in the department of physiology of the University of North Dakota have recently received a fourth grant of $[illegible] from the American Medical Association Research Fund Committee, of which Dr. Ludvig Hektoen

chairman. This grant is for the further extension of their work on the simultaneous study of the urine and blood as result of profuse sweating.

Nature reports that recent appointments to scientific and technical departments made by the Secretary of State for the Colonies include the following: Mr. D. P. McGregor, to be geologist in the Gold Coast, and Mr. K. R. S. Morris, assistant entomologist in the same colony; Mr. J. D. Shepherd to be irrigation officer, Agricultural Department, Palestine; Mr. M. Vardy to be manager, Experimental Fruit Farm, Sierra Leone; Mr. E. Messervy to be veterinary officer in Tanganyika Territory. Among the transfers and promotions are the following: Mr. H. M. Gardner, senior assistant conservator, to be conservator of forests, Kenya Colony; Mr. L. P. Henderson, agricultural instructor, Federated Malay States, to be superintendent, Agricultural Department, Nigeria. Mr. G. N. Sale, assistant conservator of forests, Cyprus, to be director of forests, Mauritius; Mr. D. Stevenson, deputy conservator of forests, British Honduras, to be senior assistant conservator of forests, Northern Rhodesia.

DR. HEBER D. CURTIS, director of the Allegheny Observatory, has sailed from New York to observe the total eclipse of the sun, which will take place on May . Dr. and Mrs. Miller, of Swarthmore College, were passengers on the same boat. The party expects to reach Sumatra on February 27, and within a week to make its way some 300 miles by automobile to the selected site in the mountains near the northern tip of Sumatra. Immediately after the eclipse, Dr. Curtis and Dr. Miller will go to Batavia in Java, where the fourth Pacific Science Congress is to be held from May 16 to 25. While there, Dr. Curtis will act as delegate to the congress for the National Academy of Sciences, the American Astronomical Society and the University of Pittsburgh. The party hopes to return July 4.

PROFESSOR HARLAN T. STETSON, head of the department of astronomy at Harvard, has been at Carleton College during February as exchange professor, giving a series of lectures on "The Development of Astronomical Thought." Dr. Stetson will also lecture at Knox and Pomona Colleges before going to the Philippines in May to observe the eclipse of the sun.

H. W. V. WILLEMS, of Delft, Holland, has been spending some months in the chemical laboratory of Geological Survey, studying methods of analyzing rocks. After some time in the Geophysical Laboratory Mr. Willems expects to spend five years in Java in connection with geological and petrographic investigations in the Dutch East Indies.

PROFESSOR F. C. GERRETSEN, of the University of Groningen and of the Groningen Agricultural Experiment Station, Holland, has arrived in this country to spend six months in the department of soil microbiology of the New Jersey Agricultural Experiment Station.

N. A. LACROIX, permanent secretary of the Paris Academy of Sciences, has been appointed delegate to the fourth Pacific Science Congress which will be held in Java in May, 1929.

SIR DOUGLAS MAWSON, professor of geology in the University of Adelaide, is in London to arrange for a scientific expedition into the region south of the Continent of Australia. If his plans mature the expedition will leave Hobart, Tasmania, toward the end of this year, which is the beginning of the southern summer.

PROFESSOR A. T. LINCOLN, professor of physical chemistry at Carleton College, has leave of absence during the present semester. He will visit the principal university and industrial centers of Europe during the next six months. During his absence his work will be in charge of Mr. Maryan P. Matuszak, instructor in physical chemistry at Ohio State University.

THE Chicago Medical Society and the Society of Sigma Xi met jointly at the Medical and Dental Arts Club, Chicago, on February 20, when Dr. Ray Lyman Wilbur, president of Stanford University, gave an address on "The Significance of the Laboratory in the Progress of Civilization." Preceding the meeting, a dinner was given at the club in honor of Dr. Wilbur.

DR. EDWIN B. HART, of the University of Wisconsin, spoke on "Iron in Nutrition" at the dinner and meeting of the Mayo Foundation, Rochester, Minn., chapter of Sigma Xi held on January 29.

DR. CHARLES P. BERKEY, of Columbia University, recently gave an address at the annual dinner of the Alumni Association of the Massachusetts Institute of Technology on Boulder Dam.

THE third Ochsner Memorial Lecture was given under the auspices of the North Side Branch of the Chicago Medical Society on February 21, by Dr. George W. Crile, Cleveland, on "The Physical Nature of Death." Preceding the lecture a dinner was given in honor of Drs. Malcolm L. Harris, president-elect of the American Medical Association, ex-presidents Arthur Dean Bevan, William Allen Pusey and Frank Billings, President William S. Thayer, of the Johns Hopkins University, and members of the Board of Trustees and other officers of the American Medical Association.

DR. FRANKLIN SUMNER EARLE, sugar cane technologist at the Tropical Plant Research Foundation at Herradura, Cuba, died on January 31, in his seventy-third year.

DR. CHARLES W. YOUNG, director of the Bender Laboratory at Albany, died on January 26. Prior to going to the Bender Laboratory some six months ago. Dr. Young spent many years in China where he was assistant professor of medicine at the Peking Union Medical School.

SIR BERTRAM WINDLE, professor of anthropology at St. Michael's College and professor of ethnology at the University of Toronto, died on February 14, at the age of seventy years.

THOMAS HENRY BLAKESLEY, known for his work in electricity and optics, died in London on February 15, at the age of eighty-one years.

DR. PAUL GERSON UNNA, honorary professor of dermatology at the University of Hamburg, Germany, died on January 29, aged seventy-eight years. Professor Unna was recognized as an authority on the histology of the skin.

BY the death of Dr. J. M. Coulter on December 24, 1928, botanical science lost one of its foremost American contributors. The esteem and admiration felt for him by many friends and students of botany found expression in a testimonial which Dr. Coulter unfortunately did not live to receive, although it is gratifying to know that news of its imminence afforded him comfort and pleasure in his last hours. The presentation of the testimonial was made on the occasion of the dinner of the Botanical Society of America and botanists in general at Hotel Astor, New York City, on December 28, 1928, by Dr. A. H. R. Buller, president of the Botanical Society of America and it was received on behalf of the family by Dr. W. Crocker, director of the Boyce-Thompson Institute for Plant Research. The testimonial took the form of a silver service and a handsomely bound volume containing expressions of appreciation from hundreds of botanists who took advantage of the opportunity to make formal acknowledgment of the debt owed to a great leader. The contributors were widespread over the United States and Canada. Notable among them was Dr. J. C. Arthur, professor emeritus of Purdue University, who was associated with Dr. Coulter in establishing the *Botanical Gazette*. Initiating and maintaining a botanical periodical of such high quality is a monumental achievement for which every American botanist must feel gratitude to the memory of Dr. Coulter. But beyond this Dr. Coulter was "the teacher par excellence" of botany in America. The development of botanical research in his department in the University of Chicago during his long administration made that institution the foremost center in botanical research in America.

SHORTLY before his death, at his own request, Dr. T. B. Osborne had been relieved of active charge of the biochemical laboratory of the Connecticut State Station and given the title of consulting biochemist. In recognition of Dr. Osborne's many years of service and his notable contributions in the field of protein chemistry, the following resolution was adopted by the board of control:

In the retirement of Thomas Burr Osborne from active charge of the biochemical laboratory, the Connecticut Agricultural Experiment Station loses one of the ablest and most valued members of its staff.

In the forty-two years that he has served on the staff, he has won distinction for himself and the station, and he is to-day one of the acknowledged leaders in his chosen fields of study, the structure of proteins and the newer aspects of nutrition. His mind has always been raising questions which he was able to define with rare precision and then with equal discernment he has devised means for their experimental investigation and solution.

The members of the board, in testimony of their recognition of his valued services, of their respect for his abilities, and of their high personal esteem, enter on their records this minute of their hearty appreciation. The members of the board further rejoice that from time to time the station may still have the benefit of his personal suggestions and advice.

THE sixty-first annual meeting of the Kansas Academy of Sciences will be held at the State Agricultural College, at Manhattan, on April 26 and 27.

THE Wisconsin Academy of Sciences, Arts and Letters, under the presidency of Dr. S. A. Barrett, of the Milwaukee Public Museum, will hold its fifty-ninth annual meeting at Yerkes Observatory, Williams Bay, Wisconsin, on April 12 and 13, 1929. It will be a joint meeting with the Wisconsin Archeological Society and the Midwest Museums Conference.

THE Fifth National Shade Tree Conference has concluded its annual meeting in New Haven. The officers elected for the ensuing year were: *President*, Dr. H. H. York, forest pathologist of the New York Conservation Commission; *Vice-president*, Dr. A. F. Burgess, in charge of the Gypsy Moth Laboratory, Melrose Highlands, Massachusetts; *Secretary-Treasurer*, Rush P. Marshall, in charge of the U. S. Forest Disease Laboratory at Yale University. Those in attendance included over forty scientific men, chiefly botanists, plant pathologists and entomologists, about the same number of practical tree men and the remainder interested visitors.

A series of popular illustrated lectures on important developments and discoveries in various fields of engineering will be given by members of the staff of the Harvard Engineering School during the spring term. The lectures are open to the public, and will be held in 110 Pierce Hall on Thursday afternoons at 4:30 beginning on February 28. The lecturers and subjects are as follows: Professor Philip Drinker, "Modern Methods of Cleaning Air"; Professor C. L. Dawes, "The Transmission of Electricity at High Voltages"; Professor E. L. Chaffee, "Vacuum Tubes and Their Application"; Professor L. C. Graton, "The Deepest Mines of the World"; Professor L. J. Johnson, "The Use of Concrete in Great Structures"; Professor C. H. Berry, "Modern Steam Machinery."

A series of national lectures has been instituted by the British Broadcasting Corporation under which, three times a year, a formal lecture of nearly an hour's duration will be delivered by an eminent authority on physical or natural science, philosophy, literature, exploration, music, art or medicine. Lectures equal in importance to the Romanes Lectures at Oxford or the Rede Lectures at Cambridge are in mind. The scheme has received the approval and support of the following distinguished authorities, who have also agreed to give the corporation the benefit of their advice on the choice of subjects and lecturers: Lord Balfour, Lord Crawford and Balcarres, Mr. H. A. L. Fisher, Sir William Hardy, Sir Frederic Kenyon, Sir Donald Macalister, Lord Ronaldshay, Sir J. J. Thomson, Sir William Bragg, Lord Crewe, Sir Israel Gollancz, Sir James Jeans, Sir Oliver Lodge, Sir Henry Newbolt, Sir Ernest Rutherford and Dr. T. F. Tout. On the recommendation of this advisory board, the first of the national lectures will be delivered on Thursday, February 28, at 9:20 P. M., by Dr. Robert Bridges, the poet laureate, whose subject will be "Poetry." The second lecture is to be delivered on April 15 by Professor A. S. Eddington.

Members of the Beebe exploring expedition are expected in Bermuda during the next three weeks. There it is planned to spend six months in deep-sea fishing, under the auspices of the department of tropical research of the New York Zoological Society. The party includes Dr. Henry Fairfield Osborn, Dr. W. K. Gregory and Dr. William Beebe. Governor Sir Louis Bois, of Bermuda, has granted the party the use of Nonsuch Island, from March to October. The island contains five acres and is partly wooded. It has alternating coral rocks and sandy beaches, and there are several buildings for laboratories. Directly off shore deep water approaches closer to Bermuda than elsewhere, a mile depth being found a few hundred feet from shore. Daily trawling with the tug *Gladisden* will be carried on for the next six months. By the aid of pressure tanks and dark rooms, both on the tug and on shore, deep-sea fish, both dead and alive, will be studied. Fish life will be studied intensively by the aid of diving helmets, submarine cameras and a fleet of six small boats, while observation will be carried on in limited areas of coral reefs. Laboratory work will be confined to observations bearing directly on life histories and the development of young fish.

The Chemical Foundation, Inc., of New York City, has made a grant to the Medical College of Virginia, Richmond, to make it possible to employ for a three-year period a full-time expert to enlarge its present program of research in chemistry as related to medicine, surgery and dentistry. The special laboratory for this work will also be considerably enlarged.

The new 225 bed Passavant Memorial Hospital, erected on the McKinlock Campus opposite Northwestern University Medical School, will open about May 1. One third of the beds in the Passavant Memorial will be available for university bedside instruction. Nine of the twelve stories will be for patients. The eleventh floor will be devoted to the operating department; the second floor to the laboratories and physical therapy department. For the present the east wing will be set aside for nurses' quarters and the nurses' school, which will be affiliated with Northwestern University. The superintendent of the hospital will be Dr. Irving S. Cutter, dean of the medical school.

UNIVERSITY AND EDUCATIONAL NOTES

Yale University is the beneficiary of a bequest estimated at $3,000,000 by the will of Mrs. Ray Tompkins, of Elmira, N. Y., who died on January 22 last at Cannes, France. Mr. Tompkins, a Yale football star, died on June 30, 1918, leaving his widow the life use of his estate, directing that if no provision was made otherwise his entire estate was to go to his alma mater. An amount estimated at $1,200,000 was bequeathed to the Arnot-Ogden Memorial Hospital, of Elmira, and approximately $450,000 to the Elmira College for Women.

Washington University School of Medicine has received a gift of $1,200,000 from the General Education Board for endowment of research and teaching in diseases of the eye, ear, nose and throat at the Oscar Johnson Institute.

Abram E. Fitkin, of New York City, has added $100,000 to the gift of $1,000,000 which he made to

Yale University last year for the erection and endowment of the Raleigh Fitkin Memorial Pavilion at the New Haven Hospital.

BY the will of Mrs. Gladys Carroll Marvin, Harvard University receives $100,000 conditional on the payment by the university of a life annuity of $10,000 to Mrs. Mabel M. Trowbridge, mother of Mrs. Marvin.

THE *Journal* of the American Medical Association reports that the offer of more than $1,000,000 by the Rockefeller Foundation to the medical school of the University of Minnesota has been withdrawn.

THE University of Toulouse will celebrate on June 9 the seven hundredth anniversary of its foundation. It is expected that the president of the republic will attend and that there will be a large representation of scholars and scientific men from France and from abroad.

DR. HAROLD L. AMOSS, associate professor of medicine at the Johns Hopkins University, has been appointed professor of medicine at Duke University.

DR. J. V. HOFMANN has resigned his position as assistant director of the Pennsylvania State School of Forestry to accept the appointment as head of the division of forestry at the State College of North Carolina at Raleigh. Dr. Hofmann took up his work in February.

DR. D. W. BRONK has been appointed professor of physiology and biophysics and head of the department of zoology and physiology at Swarthmore College. Professor Bronk has recently returned from England where he spent the past year in research at the University of Cambridge and the University of London.

DR. RAYMOND H. WALLACE, National Research Council Fellow at Columbia University, has been appointed assistant professor of botany at the Connecticut Agricultural College. Associate Professor G. Safford Torrey has been appointed professor of botany, and succeeds Dr. Edmund W. Sinnott as head of the department.

DR. MAX KLEIBER, of the staff of the Swiss Federal Polytechnic School at Zurich, will head the net energy studies to be undertaken in the animal husbandry division at the branch of the college of agriculture of the University of California, at Davis.

COLONEL F. J. M. STRATTON, secretary of the International Astronomical Union, has been elected as Professor Newall's successor with the title of professor of astrophysics in the University of Cambridge and director of the Solar Physics Observatory.

Two new professorial chairs have recently been established in Paris. The first is the chair of phthisiology, whose holder is Dr. Leon Bernard, formerly of the chair of hygiene, which is now occupied by Professor Tanon, and a chair of hydrology and climatotherapy whose first occupant is Dr. Piéry.

A CHAIR on the clinical aspects of tuberculosis and respiratory diseases has been established at the University of Rome. The newly appointed occupant of the chair is Professor Eugenio Morelli, the pupil and successor of Forlanini.

DR. HEINRICH VOGT, professor of astronomy in the University of Heidelberg, has been called to Jena.

DISCUSSION

NOTE ON THE GEOLOGIC AGE OF PITHECANTHROPUS AND EOANTHROPUS

IT is a singular coincidence that the original estimates of the geologic age of both the Trinil ape-man of Java (*Pithecanthropus*) and the Piltdown dawn-man of Sussex (*Eoanthropus*) are being revised at the present time.

Pithecanthropus when discovered was regarded a[s] of Upper Pliocene age—a proper geologic positio[n] for the supposedly ancient ancestral link in th[e] human chain. It now seems almost certain tha[t] *Pithecanthropus* is of Middle Pleistocene age, since, a[s] Dietrich and Osborn have pointed out, Proboscidea[ns] and other quadrupeds among which *Pithecanthropu[s]* lived are apparently Middle Pleistocene and *certain[ly]* not Lower Pleistocene, still less Pliocene. Profess[or] Osborn has written Professor Dietrich, of Berlin, t[o] go over this paleontologic evidence again becaus[e] unless it can be challenged it proves that *Pithecanthro[pus]* is another instance of the survival of a ver[y] primitive type of mammal in a primitive forested en[vironment] where food was plenty, there was littl[e] need of clothing, and safety was assured by concea[l]ment or flight rather than by combat with weapon[s].

On the other hand, the case of *Eoanthropus* (Pil[t]down man) is quite different; its darkly colored a[nd] thoroughly fossilized skull fragments are intermingl[ed] with fragments of grinding teeth of Proboscideans [of] unquestionable Upper Pliocene age, namely, the sp[e]cies *Archidiskodon planifrons* and *Anancus arverne[n]sis.* If *Eoanthropus* belongs with these teeth it [is] surely Upper Pliocene, but intermingled in the Pi[lt]down gravels are other tooth fragments of somewh[at] lighter color belonging to the hippopotamus which [in] Great Britain was a Lower Pleistocene inhabita[nt]. By this mixed evidence it is demonstrated that t[he]

Eoanthropus skull was probably a washout river channel specimen from some old sand or gravel bank and the problem is whether it came from a Pliocene gravel bank with the primitive elephant and mastodon, or from a Pleistocene gravel bank with a primitive hippopotamus.

In either case *Eoanthropus*, the dawn-man of Sussex, now appears to be of greater geologic age than *Pithecanthropus*, the Trinil ape-man. Thus in the course of the last eighteen years *Eoanthropus* and *Pithecanthropus* have changed places in the geologic time scale.

Henry Fairfield Osborn

American Museum of Natural History

GROUP THEORY AND APPLIED MATHEMATICS

Professor H. Weyl, of Zurich, Switzerland, recently published a book under the title, "Gruppentheorie und Quantenmechanik," Leipzig, 1928, which he regards as half mathematics and half physics, and hence it belongs to the borderland of two large domains of science. Group theory is not a complete stranger in this borderland. Its usefulness in crystallography, for instance, is well known. The fact that it appears to be useful in such a new field of mathematical physics as quantum mechanics may perhaps be regarded as a sign that the mathematical public is becoming more conversant with the fundamental notions involved in group theory and hence writers no longer hesitate to express themselves in the language of this subject in case they are familiar with it.

Professor Simon Newcomb once said[1] that "the mathematics of the twenty-first century may be very different from our own; perhaps the schoolboy will begin algebra with the theory of substitution groups, as he might now but for inherited habits." We seem to be as yet very far from such a fundamental change in our courses in elementary mathematics, and the change is not likely to come until applied mathematicians make much more use of this theory. Two fundamental aspects of mathematics are idealization and actualization. As regards group theory the former concerns itself with a study of the structure and the abstract properties of groups, while the latter makes groups useful in the intellectual penetration of our actual surroundings in the physical world. The development of these two aspects of the subject seems to call for very different types of mind, and the latter naturally gives rise to the more extensive developments. It is in this field that group theory seems to be as yet in its infancy and hence one welcomes the more heartily such works as those of Professor Weyl.

In connecting group theory and quantum mechanics Professor Weyl directs attention to the fact that the former subject is in reality very old and may have been at the base of the early developments of ornaments, especially by the ancient Egyptians. He thus partly supports the view that the earliest developments in mathematics may have been inspired by a sense of beauty and harmony as exhibited in symmetrical geometric figures, and that when Euclid wrote his "Elements" the fundamental concept of group was so fully ingrained in the minds of the people that Euclid did not regard it as necessary to mention it explicitly. The emphasis which it began to receive during the nineteenth century is so marked that the late Felix Klein regarded it as the most characteristic feature of the mathematical developments during this century. Its essence is a study of a few fundamental laws of mathematical operations, and it has created for itself a marvelously rich but isolated mathematical universe which has proved to be very attractive to a number of pure mathematicians, who are accustomed to ignore their actual physical surroundings in their intellectual activities and to study ideal situations.

While the applied mathematician is not accustomed to such isolation and hence can not be expected to enter with as much enthusiasm as the pure mathematician upon the study of the particular laws involved in group theory, yet he seems to realize more and more that the actualization of such a rich store of abstract mathematical knowledge is likely to extend his insight into our actual physical surroundings. Hence it seems reasonable to expect that in line with the work noted above more and more frequent use of group theory will be made in the future by applied mathematicians, but that some of the most optimistic statements relating to this use will not be realized in view of the fact that those who are continually reminded of laws which are not considered in group theory will be more forcibly impressed by its limitations than the idealists.

G. A. Miller

University of Illinois

[1] *Bulletin of the American Mathematical Society*, 3: 107. 1893.

THE MOVEMENT OF SAP IN PLANTS

Very great interest has been roused in Europe and America by the striking researches and discoveries of Sir J. C. Bose on the unity of physiological mechanism in the plant and in the animal. After the conclusion of his lecture at the University of Vienna, Sir J. C. Bose was kind enough to lend me his instruments for the repetition of his more important experiments in the institute of plant physiology of the university. As this is the first time that his

experiments have been successfully repeated in a European laboratory, the following results which I obtained, will, no doubt, prove of interest.

(1) *The infinitesimal contraction recorder:* This apparatus, a marvel of ingenuity, records the cellular contraction in the interior of the plant under external stimulation. The principle of the instrument is extremely simple; the extreme delicacy of the apparatus bears testimony to the extraordinary skill of the Indian mechanicians trained at the Bose Institute. The stem or other organs of the plants are placed between a fixed and movable primary lever. The diametric contraction of the plant under stimulation is indicated by the movement of this primary lever, which is further magnified by optical means, the total magnification produced being a million times. The indication of the instrument is not affected by mechanical disturbances.

(2) *Sensitiveness of ordinary plants:* An extremely feeble electric shock was sent through me and the plant, both being places in the same electric circuit. It was a startling revelation that the plant should visibly respond by a contraction to a shock which was below the threshold of my perception. With stronger shock the cellular contraction was more intense; under excessively strong shocks the contractile spasm became very violent; after a short time the tissue ceased to respond, being effectively killed by the electric discharge. It is quite easy to show that the cortical cells in every section of the stem and of the leaf-joint are fully sensitive, proving a continuity of contractile cortex throughout the length of the plant. A wave of peristaltic contraction may thus sweep onward from the point of stimulation.

(3) *The movement of sap:* The following striking experiment affords conclusive proof that the movement of sap is essentially not a physical but a physiological process. A cut piece of stem of Antirrhinum with a pair of opposite leaves is suitably held at the cut end by a piece of sponge. Under excessive drought the leaves fall down, become crumpled up and appear to be wilted. A few drops of cardiac stimulant—dilute solution of camphor—applied on the sponge bring about a most striking transformation. The drooping leaves are quickly revived; they rear themselves up with great rapidity, and become fully erect in the course of two to three minutes.

(4) *Active cellular pulsation in propulsion of sap:* The pumping of sap by the propulsive layer is clearly demonstrated by the optical sphygmograph. The flow of sap along the stem is observed to consist of a series of pulsations. The pulsatory activity is greatly increased by drugs which enhance cardiac activity in the animal; it is enfeebled or arrested by depressing agents. Extracts from certain Indian plants are seen to have a potent influence in the propulsive activity of the plant and cardiac activity of the animal. This aspect of the investigation has roused considerable interest in the Medical Faculty of Vienna.

(5) *Movement of sap in sealed stems:* It has been thought that the movement of sap is essentially due to push from below by root-pressure and suction from above by transpiring leaves. The fact that there is an inherent activity in the stem itself, independent of those in terminal organs, is clearly demonstrated by experiments on an isolated stem covered with impermeable varnish. The sap can now be made to flow either upwards or downwards, according to differential stimulation. The law of directive movement of sap is that it moves from the stimulated to unstimulated or depressed regions. The cellular mechanism is highly sensitive, being automatically adjusted for subserving the well-being of the plant. A local depression or stimulation starts the alert machinery into action, making the sap rush towards the depressed or away from the overstimulated region. It is in this way that chemical substances stored in one region are conveyed to distant parts. By this hydraulic mechanism the plant as a whole becomes an organized unity.

H. Molisch

Vienna, Austria

STOMATA WHICH SHOW FUNCTIONAL MOVEMENT FOR A CENTURY

The establishment of the fact that medullary cells of the tree cactus of Arizona live for more than a century and have a capacity for enlargement during the greater part of this period at the Desert Laboratory early in 1926 has been followed by the discovery of long-lived cells in the cortex of both Carnegiea and Ferocactus, in the medullary rays of the California redwood (Sequoia) and of both medullary and wood-cells in Parkinsonia. The living elements in question are in such relations to other tissues as to be well protected from sudden or intense action of environmental agencies and do not appear to be the seat of rapid metabolic activity.

While collaborating in the preparation of one of the brief papers concerning this subject it appeared that the stomatal cells of the tree cactus (Carnegiea) also sustained a long period of functional activity, as mentioned by MacDougal and Brown.[1] This matter was held for continued observation. On a trunk of this massive cactus 10 meters in height the green epidermis persists to within a meter of its base, where it is displaced by bark or corky tissue. This is taken to mean that all the epidermis except

[1] D. T. MacDougal and J. G. Brown, "Living Cells Two and a Half Centuries Old, Science, lxvii, 447–448, 1928.

that formed during the first ten to twenty years of the life of the plant is alive.

The developmental period of stomata in *Carnegiea gigantea* is very short. Material two centimeters from the growing-point contains only well-developed stomata. The developmental stages of the guard cells are found within a few millimeters of the growing-point at the apex of the stem or branches. They reach full size within less than a month, and since plants of this species often live more than a century the life of the plant is more than twelve hundred times the duration of the stomatal growing-period.

A study of the movements of the guard-cells of a seedling seven months old showed them to be wide open at 5:30 A. M., soon after daybreak, gradually closing throughout the morning to a slit at noon. This slight opening remained until after the middle of the afternoon, and by nine o'clock at night they were completely closed. Epidermis from the base of a giant which contained representative guard-cells of great age showed the stomata open at daylight, closed to half the size by eight-thirty in the morning, either closed or with a slit opening at noon, and then completely closed until after ten at night, when they began to open again. This is a program largely in reverse of that shown by leaves of most plants, especially those living in moist regions in the tropics.

The guard-cells of the stomata are larger than the adjacent epidermal cells and open into a wax-lined sub-stomatal chamber which extends entirely through the hypodermal tissue, which may have as many as ten layers of cells in older parts of the stem. The changes coming with age which may affect the guard cells are easily observable. These elements are in direct contact with the turgid cells of the hypodermal layer for the first few years of their existence, and exchanges of water and other material may take place readily. The earlier contact with a thin-walled tissue containing chlorophyll facilitates the reception of material by the active guard-cells. Later the walls of the hypodermal cells thicken and the readiest communication is through the pits to the cortex. The best communication is perhaps with the neighboring epidermal cells. The external walls of the guard-cells also become heavily cutinized with age.

However, in spite of all these changes in the adjacent cells, these guard-cells retain the power of motion for perhaps a century. Then comes a time when some other changes take place which stop the functioning. The waxy cuticle disintegrates and masses of waxlike material clog the stoma and spread in uneven golden brown masses over the epidermis. This is the transition stage and occupies the region of green tissue nearest the base adjacent to the brown corky layers. The stomata disintegrate with the transformation of the outer layers into cortical tissues.

The developmental or growth period of the stomatal cells is not longer than a month; life and activity, including movements of the guard-cells, may continue for a century or more, or twelve hundred times as long as the formative period. The transformations of energy upon which daily action is based and the widely ranging conditions of temperature to which all epidermal elements are subject make the stomatal cells of Carnegiea one of the most remarkable cases of endurance of protoplasts yet recorded. The other epidermal cells which endure for a similar period are hardly less notable.

FRANCES L. LONG

CARMEL, CALIFORNIA

PRESS SERVICE

WITHIN the past few years interest in science in the United States has so increased that several of the press associations and even a number of the larger newspapers have appointed science editors whose special duty it is to seek out and to present in popular phraseology information of current interest on scientific subjects.

In appointing science editors the general policy has been to select writers of unusual ability and of proved accuracy rather than to designate as science editors writers with previous scientific training.

This is a wise policy, for a writer must always maintain the closest possible contact with the public whom he serves, and must be able at all times to appraise the ever changing public interest in the varied lines of scientific work unbiased by personal preferences arising from that specialization which is inseparable from scientific training.

While this policy insures the necessary, and indeed essential, closeness of contact between the general public and the science editors, the contacts between the science editors and the great body of scientific workers who represent the source of their material are less intimate than is desirable.

In addition to the science editors there is an increasing number of feature writers who to a greater or lesser degree specialize in science and would do so to a much greater extent if it were possible for them to secure the necessary material.

Recognizing the desirability of bringing about a closer accord between research workers and the representatives of the press, the association at the New York meeting established the American Association Press Service.

The function of the press service is threefold. In the first place, material sent in at any time during the year will be made available to writers with the under-

standing that the articles prepared by them will be submitted for revision to insure accuracy, and carbon copies of the articles as sent to press will be filed with the association. In the second place, writers desiring material for an article on any scientific subject on application to the association will be referred to a recognized authority on that subject who is willing to provide the information wanted, subject to final revision of the completed story. In the third place, any article written by a popular writer may be sent in for examination in regard to its accuracy.

Thus the press service provides a contact heretofore lacking between the research workers and the press. All material sent in will be brought to the attention of the press representatives for their consideration in much the same manner as at the annual meetings. Whether the material is used or not is a matter for the press representatives to decide.

The object of the press service is to provide a channel through which the results of research work may be made public, and at the same time a source of original material for writers. No stories or articles of any kind will be sent out by the press service for publication directly. Writing for the public press is a highly specialized occupation requiring long and arduous training and extensive and varied experience. The press service aims to meet the growing demand for accurate and readable information on scientific subjects, and not through competition to discourage those endeavoring to meet that demand.

It is understood that SCIENCE, the official organ of the association, reserves the right to publish any item or article sent in to the press service; but this does not interfere in any way with the publication of the same item or article, rewritten, in a newspaper or magazine.

The press service of the association represents a line of activity not previously attempted by any scientific body. Through its successful operation the association as a whole as well as the individual members, and, on the other hand, the vast reading public of America, will greatly benefit.

AUSTIN H. CLARK

BOOK REVIEWS IN SCIENCE

THE reviewing of scientific books is the most difficult situation that the editor of SCIENCE must meet. There are now published in English and in other languages so many books that only a small proportion of them can be reviewed in any one journal. An editor can not be competent in diverse subjects. If specialists in each are asked to take charge, as was formerly done, there is difficulty in obtaining from them impartiality, promptness and coordination. They are naturally more interested in their subject than in the journal.

When the field covered is so large, the limited space is a serious difficulty. Comparisons, perhaps odious to our pride, are sometimes made between the reviews in SCIENCE and in *Nature*. It should be remembered that the subscription price of *Nature* is £2/12s. (foreign £2/17s.), whereas SCIENCE is supplied for \$3.00. It might conceivably be better to make the membership dues of the American Association for the Advancement of Science \$20.00 or \$25.00 and spend on SCIENCE \$18.00, which would be about the equivalent of £2/12s. in England. Then ample space could be provided and review editors could be found who would give adequate attention to the work.

A large membership of the association and a corresponding number of readers of SCIENCE may, however, be preferable to a larger and more expensively produced journal. The British Association for the Advancement of Science has just now asked the American Association to join with it in protesting against the high cost of German scientific journals. It may be that later the advertising in SCIENCE as the circulation increases (it is now over 14,000) will make improvement and enlargement possible without additional cost to the association. Members can forward this desirable end by increasing the membership of the association among scientific men and by making use of the advertisements when that can be done to advantage. For example, a firm expressed satisfaction when a scientific man informed it that he had ordered for his institution apparatus costing \$4,000 owing to an advertisement in SCIENCE.

The financial problem is not the only one in connection with the reviewing of books. SCIENCE aims to be objective and impartial. Articles are accepted on the guarantee of the standing of the scientific man and the supposed value and suitability of the contribution, the editor obtaining expert advice when there appears to be any question. As a matter of fact very few contributions are sent to SCIENCE that do not deserve publication; it is nearly always a question only of limitations of space. Editorial opinions are not expressed as such. In the notes even comparatively innocuous words such as "interesting" and "important" are avoided; they are cut out hundreds of times from contributed news notes. If, as in the present instance, it seems desirable to express opinions the communication is signed and is printed in the department open to any scientific man.

In the case of reviews the situation is different, for the editor must select the books to be reviewed and find the reviewers. Authors and publishers not only urge reviews of their books, but often suggest re-

viewers and sometimes send in reviews. Reviews are sent in from friends of authors and occasionally from those unfriendly to them. The editor must assume a responsibility that does not hold for other departments.[1]

It is in most cases possible to obtain either a laudatory or a critical review of any book. For many years there were in England two leading literary publications, *The Academy* and *The Athenaeum.* In the former the reviews were signed and usually favorable; in the latter they were unsigned and likely to be critical. There were published last year extended reviews of the same book in SCIENCE and in *Nature,* both by distinguished experts in the field. The signed review in SCIENCE gave an adequate account of the contents of the book, discussion of its subject-matter, due praise and several critical suggestions; the unsigned review in *Nature* was throughout extremely condemnatory. The present writer happens to know that the review in *Nature* was written by one who had long been engaged in scientific and personal controversy with the author of the book. Of course the situation in reference to this book in the two journals might just as well have been reversed, except that all reviews in SCIENCE are signed. Reviewers hesitate to criticize; indeed they generally decline to write a review if in their opinion it should be unfavorable.

[1] A paragraph is omitted here in view of the following letter written under date of February 4, 1929, from the president of the Yale University Press:

"When I called upon you in New York recently I expressed our regret that some years ago a sales manager of the Yale University Press, who is no longer with us, should have cancelled advertising in SCIENCE following its publication of a review of a book of ours to which we took exception. In coming to see you as I did I desired also to make evident to you my regret that I should not have taken steps, as soon as I learned of the review, which might either have prevented such action on our part in the first instance or else have resulted in its prompt reversal when you wrote to inform me of it.

"You have told me that you now intend to publish in SCIENCE a reference to the matter and comment concerning it. I have no wish to request you not to do so, and no desire to escape criticism which may be directed against me because of my own shortcomings in the affair for which I have apologized. It is, however, my hope that no criticism will be directed against those who are now responsible for the conduct of the editorial and of the sales departments of the press. I shall hope, too, that you will realize that action such as that mentioned is not in accord with the policy of the Yale University Press, or in harmony with its traditions.

"Should you wish to publish this letter of mine in SCIENCE you are at liberty to do so."

Articles printed in SCIENCE are usually prepared for other purposes, as for an address on some special occasion, or because an author wishes to announce the results of his work. The time of scientific men valuable for research is not often spent in writing articles expressly for SCIENCE. The editor can examine articles submitted and obtain opinions on them, accepting those that seem most suitable and asking for abridgment or rewriting when that seems to be desirable. If he asks to be allowed to examine an address or the like that is already written he can make conditions in regard to its suitability. The situation is different with reviews. They must be solicited; they must be expressly and should be promptly written. The most competent authorities very properly regard their time as of greater value for other purposes; when a review is printed this is also sometimes the opinion of the readers. The editor can not well reject a review for which he has asked, least of all when this might imply censorship of the opinions expressed. It is difficult to obtain a substitute when a reviewer delays or finally fails to prepare the manuscript.

It is an open question whether in a journal addressed to all scientific men and intended to advance their research, their influence and their interests, it is better to devote ten pages to an address reviewing progress in a given science, to five special articles containing the results of research, to news notes, to discussion of topics of current interest, or to reviews. Opinions differ greatly. Scientific men have argued that at least half the space of SCIENCE should be devoted to reviews; one has remarked that a review is of interest only to three people—the author of the book, its publisher and the writer of the review. If it is decided that it is desirable to devote a certain number of pages to reviews of books, the questions remain whether there shall be a few extended reviews or numerous shorter notes, whether treatises containing the results of specialized research or books of more general character shall be selected, whether American books and books in English shall be favored, whether preference shall be given to easily accessible books or to those which might otherwise escape attention, whether the reviews shall be only informative about the book, discuss the field covered by the book or be critical; whether they shall be written by leading specialists or by those who may have greater literary facility.

In spite of limitations of space and editorial difficulties, there should probably be book reviews in SCIENCE. When prices were doubled (the cost of paper increased fourfold) during and after the war, it was necessary to reduce the size of the journal.

Now the cost of paper at least has decreased, SCIENCE is printed efficiently and economically in its own press, and the advertising has increased. These circumstances make it possible to print about as much material as formerly, though the increasing number of scientific men makes more exacting demands on space. There are now perhaps eight times as many men engaged in research in the United States as there were in 1894, when the present editor of SCIENCE took charge of the work.

Probably the methods adopted by SCIENCE, but for the reasons given somewhat slighted in recent years, are desirable. These include finding advisers in each subject who will consent to assist in planning and obtaining reviews. There should then be arrangements to print once or twice a year a review article in each subject, covering its advances with brief reference to text-books and general treatments; similar articles on fields of research with reference to specialized treatises and monographs; each week two or three somewhat extended reviews of books selected for their importance and general interest. Books must be chosen with some reference to the feasibility of obtaining a reviewer who is not only competent in the subject but who can write in a way that will make the review of interest to a considerable percentage of the readers of SCIENCE.

This program is admittedly difficult. The present note is written in order to ask the advice and cooperation of scientific men who may be willing to do what their time permits to make the journal of their national association as influential and as useful as may be.

J. MCKEEN CATTELL

SPECIAL CORRESPONDENCE

THE PRINCETON-BUFFALO EXPEDITION TO THE WEST INDIES

DURING the latter half of July an oceanographic and stratigraphical survey was made of the Bahama region, embracing a traverse of the Gulf Stream from Miami to Bimini; the Great Bahama Bank; the West Coast of Andros Island; the South Bight; the East Coast of Andros and the Tongue of the Ocean, from Golding Cay to Nassau. The expedition was sponsored by the Summer School of Geology and Natural Resources, of Princeton University, and the Buffalo Society of Natural Sciences. The purpose of the expedition was to continue the work started by the first expedition last winter, and to study the region under summer conditions and maximum temperatures. During the winter trip the weather was so stormy that the shallow waters over the Great Bahama Bank were in a constant state of agitation, and not a single glimpse of the bottom could be obtained during the entire time at sea. The results of this trip have already been published.[1] Further and more detailed studies are now being carried on at the Buffalo Society of Natural Sciences and at Princeton University, and will appear shortly.

It has been the authors' belief, for some time, that the region of the West Indies affords an excellent natural laboratory for the study of oceanographic phenomena which should have a direct bearing on paleoceanographic and tectonic problems, and it is interesting to note that the Dutch are planning an expedition to study the eastern portion of the East Indian Archipelago for the same reason, as reported in a recent issue of SCIENCE.

During the recent expedition to the Bahamas, special emphasis was paid to the collection of plankton and a study of the bottom fauna, especially in the shallow waters off the West Coast of Andros Island and in the South Bight.

On crossing the Gulf Stream the usual rich plankton community was encountered, consisting of the customary tropical adult species and also large numbers of fish eggs and young stages of various invertebrates. The most surprising result of the collections from this area proved to be the occurrence of *Calanus finmarchicus*. As it has not heretofore been taken south of the latitude of Chesapeake Bay on the Atlantic coast, its presence in the straits of Florida is most surprising. According to Bigelow,

> So far as known, the latitude of Chesapeake Bay may be set as the southerly limit of its occurrence off the east coast of the United States in numbers sufficient to color the plankton at any season. Westward and southward from abreast of Cape Sable the zones of abundance for *Calanus finmarchicus* are bounded off-shore by the high temperatures and salinities of the Gulf Stream.

One would hardly expect to find this typically cold-water species in midsummer in the superheated water between Miami and the Island of Bimini. It is apparently added evidence of a drift from the north which passes between the Gulf Stream and the shore all along the Atlantic coast and may even be traced around the tip of Florida, where it passes just outside of the line of the islands. Although there is, no doubt, little chance that the species could establish itself in the tropics, those taken were alive and in

[1] R. M. Field, "Suggestions as to the Study of Marine Sediments," *The Canadian Field-Naturalist*, May, 1928, pp. 119 to 122, and map; and R. M. Field, "The Great Bahama Bank. A Study in Marine Carbonate Sedimentation," *American Journal of Science*, September, 1928, pp. 239–246.

good condition. Several cases of southern forms entering the northern waters have been reported, but so far as we know, on the Atlantic coast no northern boreal species has been observed so far south. The inability to reproduce in water of unfavorable temperature prevents the species from becoming established. It may be that when paleoceanography is better understood fossil examples of this sort of occurrence may be found.

Proceeding from Bimini over the shallow carbonate banks the larger plankton species become gradually less abundant both in number and variety. The average temperature of the water on the banks was 86. Close to shore the temperature was between 90 and 92. Although capable of supporting a scattered sponge colony, the water appears to be particularly devoid of life. The abundance of protozoa and diatoms has not as yet been determined, but it is safe to say that what life there is over the 20,000 square miles of lime bottom derives its food materials from the Gulf Stream and other surrounding waters. Very little can come from the low islands of the vicinity. The soft and unconsolidated bottom is everywhere punctured by several species of burrowing organisms. The holes and tunnels are very closely spaced so that the sediments are being worked over and over again. It is hoped that further studies on the biology of this region may throw important light on some of the geological and ecological problems which are now under investigation.

It is possible that the southwestward curve of the Florida keys or reefs may be due, in part, to a southward drift or current which, while not strong enough in itself to be easily detected or to influence directly the shape of the reef, may do so indirectly by the fact that it carries the principal food supply. There is good evidence to show, as cited above, that the paucity of the life on the Bahama Banks is largely due, not to the bottom conditions, but rather to lack of food supply. It is reasonable to believe that were there more plankton in these shallow waters there would be more corals and sponges. It is an interesting fact that the more or less constant stir-up of the fine calcareous muds (Drewite) seems to have little or no effect upon the sessile benthos, and certain types, such as the sponges, remain buried in the "mud" for several weeks without apparent hurt. There is also evidence that the sponges bury themselves in the carbonate mud during the reproductive period. It seems probable, therefore, that the paucity and character of the life in our epeiric Paleozoic seas, especially as represented by certain limestone and dolomite formations, may be directly the result of the poverty of the plankton, and not because of bottom conditions. Where we can trace the geographic distribution of Paleozoic plankton forms, such as the ostracods and graptolites, this would suggest the directions of the currents which must have carried the eggs and young stages of the adult sessile forms, and thus prove a valuable check on the source and migration of faunas. As so ably emphasized by Dr. E. O. Ulrich, the migration of faunas is one of the most important problems in Paleozoic stratigraphy and paleogeography, and the colonization by the bottom forms must have been partly controlled in the past—just as now—by the direction of ocean currents. It is also suggested that "land barriers" may have been overemphasized in paleogeographic problems and that "bottom control" may be more or less of a negligent factor in the shallow, warm Paleozoic seas, especially where carbonate sediments were being deposited.

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SCIENTIFIC BOOKS

The Normal and Pathological Physiology of Bone. By R. Leriche and A. Policard. Translated from the French by Sherwood Moore and J. Albert Key. The C. V. Mosby Company, 1928. 246 pages, 33 figures.

This book is welcome because it is a well-balanced, sane and at the same time a highly original and suggestive account of a branch of physiology which has really been created within the last few years. The authors themselves say that recent researches on rickets have shown us "the capital importance of factors of which no one had dreamed. A few works in biochemistry have done more than almost a century of pathological anatomy."

That the presentation is authoritative is shown by the remarkable fact that although the most recent and debatable advances are discussed, Moore and Key, working in this country, state that they are "in accord with Professors Leriche and Policard in principle throughout, though differing to some extent in regard to details. Where this is true the divergence of views is embodied in footnotes."

The plan of the book is synthetic. A conception of the place of bone in vital activities is built up by a careful consideration of investigations on the subject pursued from many angles by anatomists, physiologists, radiologists, surgeons and others. To create this picture the authors have built upon the foundations laid by those who have gone before. But a tedious review of the literature is not presented.

Credit is given where it is due with discernment in the proper places and is documented by an extensive and detailed bibliography.

That bone is formed through a metaplasia of connective tissue is demonstrated, and the fundamental similarity of the process in all conditions both normal and pathological is emphasized. It is with bone as a skeletal material determining the architecture of the body that the book deals, though appropriate and necessarily brief reference is made to its rôle as a calcium reservoir and as a site for blood formation. Ossification and resorption are considered in detail. A whole chapter, which should prove enlightening to the medical profession, is devoted to the periosteum. Chapters VII and VIII on the repair of fractures and on bone transplantations also supply information of great practical value. The illustrations are few in number but well chosen, for each one of them makes a certain point clear which would otherwise have required pages of text.

To the human biologist it is the last chapter which will prove of all the most stimulating. In it will be found a conservative statement of just how far the misshapen human skeleton can be corrected by the purposeful control of bone resorption and bone formation. A partial answer, in the affirmative, is given to the question "Can one model new ossifications?" because therein lies our hope of constructively recasting the bodies of the many unfortunates in our midst. The book looks to the future, and the translation with its accurate rendering of the complex shades of meaning of the French original makes the presentation available to what I believe will be a much larger group of interested readers.

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Locusts and Grasshoppers: a Handbook for their Study and Control. By B. P. UVAROV, London, The Imperial Bureau of Entomology (1928), royal octavo +, xiii + 352, 118 text illustrations, 8 plates.

THE original edition of this important book was published in the Russian language at Moscow by the Central Cotton Committee in 1927; but this English edition differs essentially, and is much fuller and of much broader interest. It has, in fact, been made not only available but adaptable to all parts of the world, and of course this has necessitated the addition of whole chapters.

The author, already a man of sound training and a well-known student of the Orthoptera, has since the war been connected with the Imperial Bureau of Entomology in London, where, as one of the collaborators on the *Review of Applied Entomology,* he has gained a close acquaintance with the world literature on the subject, and is thus well fitted to put out an authoritative book.

The locust or grasshopper problem has been the despair of many nations, and has undoubtedly in earlier days influenced the trend of civilization. Famine, resulting from crop devastations by locusts, is commonplace in the annals of many countries. Writings about locusts surpass in bulk those about any other group of insects. Man's struggles against them have largely failed in spite of his desperate attempts to save at least a portion of his crops. The fight has been so long and so continuous that at last we are beginning to view the problem in its broader aspects, and it is in its consideration of these broader aspects that this book has its very especial value. In our knowledge of the broad factors of the ecology of migratory locusts there are many gaps, and Uvarov is insistent in pointing out not only what is known but what is still unknown and must be studied by prepared minds.

The book is very comprehensive, including chapters on external morphology, anatomy and physiology, development and transformations, behavior, ecology and distribution, natural enemies, periodicity of mass outbreaks, technique of control and organization of control. To these chapters is added a special part in which the particularly celebrated locusts of the different parts of the world are considered. The chapters of this special part take up the especial locust and grasshopper problems of Europe, Asia, Africa, South, Central and North America and Australia.

American entomologists have been led to a general belief that to the English all short-horned grasshoppers (Acridiidae) are "locusts," whereas we have called them all "grasshoppers," reserving the name *locusts* to the Locustidae, or "long-horned grasshoppers." And the terminology here has been further complicated by the so-called "seventeen-year locust"—a misnomer started by our Puritan ancestors. Of course, this insect does not even belong to the same order. Mr. Uvarov's decision, therefore, to reserve the term *locust* to the migratory Acridiidae, and the term *grasshopper* to the non-migratory species of this family, is novel, but is all right if every one adopts it.

The frontispiece is an outline map on which the locust and grasshopper areas of the world are marked. The author is obviously mistaken in showing a large part of the United States as "subject to regular plagues of locusts and grasshoppers" and the rest of the country as "invaded occasionally." It is more than half a century since any migratory grasshopper or "locust" has done the slightest damage to crops

in this country. Non-migratory species, however, are always with us, and must be fought by the farmers in some region or another almost every year.

Americans, however, must not be too sure that, even after much more than half a century breathing spell, our northwest territory may not again be devastated by the old "Colorado grasshopper," as it was called in the seventies. Uvarov and other entomologists have shown that that insect is simply a long-winged phase of a common and always present grasshopper known as *Melanoplus atlanis*, a conclusion suggested as early as 1886 by Scudder. Uvarov, in fact, quotes approvingly the following statement by Hebbard (1910): "When it will again burst forth to devastate not only counties but even states, is purely a matter of conjecture." Uvarov is not satisfied with the general statement made in this country that by the advance of civilization into the breeding-grounds of this species its possibilities for harm have been made to vanish. What were the ecological changes brought about by this advance of civilization? And why should they have stopped this occasional enormous breeding of the long-winged phase? This very question shows pointedly the author's mental attitude towards these great problems.

The book is a remarkable compendium, brought together by a deep student and broad thinker, and it is prepared in such a way that a mastery of its contents will prepare officials considering locust plagues in any part of the world to begin their work in a sensible and competent way. I predict that it will soon be found in the hands of such persons the world over.

We must be grateful to Mr. Uvarov for this result of his long work. And its publication in this fine form by the Imperial Bureau of Entomology places the rest of the world under added obligations to that admirable institution.

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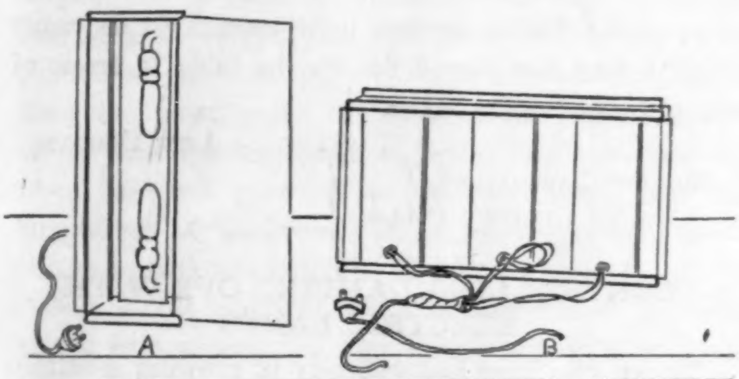
SCIENTIFIC APPARATUS AND LABORATORY METHODS

ILLUMINATION OF ANATOMICAL PREPARATIONS

THESE lighting boxes were designed to illuminate transparent specimens cleared in glycerine solution or in wintergreen oil. They are placed directly behind the specimen so that the light will pass through the thickest part of the preparation and show details otherwise impossible to see. They have been used to demonstrate a variety of semi-transparent preparations, such as sections of tissues and organs, injected blood-vessels, translucent animals and lantern slides. They are simply and cheaply made and are adapted to museum case exhibits or to demonstrations in the laboratory and lecture room, being easy to carry about and to attach wherever electric outlets are within reasonable distance. They are especially efficient in the corridors to classrooms and near elevator entrances, regions where there is usually little competition from daylight but much coming and going by those who may happen to be interested in the exhibits displayed. In such places right lighting and labeling may do a good deal of wayside teaching.

These boxes are made of thin sheet iron, ground glass and strips of half-inch asbestos board upon which miniature Mazda lamps are mounted. The accompanying figure shows one box in front view with the ground glass slipped to one side to display the lamps within (A), and another in back view with its attachment cord shown cut, because of its length, which for general use should be given a generous allowance. The boxes are similarly made; the two sizes shown have been found convenient for a variety of specimens.



Diagrams of front (A) and back (B) views of boxes for illuminating anatomical preparations.

The box at the left measures five by thirteen inches and is four and a quarter inches deep. It is most convenient for lighting tall narrow specimens, but it may be turned over on its side for use with those which are broad and flat. The sides and ends are made of sheet iron. The front edge of the sheet iron is bent into an open fold at the top, bottom and one side. On the opposite side the front edge is simply turned back flat and cut off so that the ground glass may be slipped into the grooves made by the folds at the top and bottom (A). At the back the iron is similarly bent into an open fold at the top, bottom and one side, with a simple flat turn on the edge opposite, but here the folds are made wide enough to allow the half-inch asbestos board to slip into the grooves thus formed. The board fits closely to the top and bottom but a considerable space on either

side of it allows the air to circulate and prevents overheating. The asbestos is perforated for wiring, then slipped into place and the lamps are mounted upon it with the cords carried out behind as indicated.

The box shown in back view at the right (B) is made like the other except that in it there are three strips of asbestos with open spaces between them. Each strip is three inches wide and has one lamp mounted at the center of it. Several specimens may be lighted at one time by this box or six to eight lantern slides may be shown. A cheap support for the lantern slides can be made from a sheet of galvanized tin of the same size as the front of the box. When the windows are cut in this the tin at their upper and lower edges is folded back so as to make a groove. Above and below the openings in these grooves the slides may be moved and held in place. When finished the upper edge of the sheet is clipped to the top of the box for support. Exhibits intended to be at all permanent are improved by masks which conceal the extraneous accessories and extra light. Such masks are made of medium-weight black paper in which openings are easily cut. The paper is then lightly pasted to a sheet of window-glass a little larger than the front of the box against which it is supported. Labels receive light enough to be easily read if they are placed flat on the table in front of the openings in the mask.

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CONTROLLING DAMPING-OFF WITH ELECTRIC LAMPS

THOSE who have had difficulty in growing seedlings because of the damping-off fungus during dull, moist weather may be interested in a simple method that has given complete control on pure lines of cucumber seedlings which are very susceptible to the fungus. Pure lines which have been weakened by selfing are slow to germinate during the autumn and winter months because the soil does not receive the sun's heat as it does during the summer. Also, old seed will not germinate well unless optimum conditions are supplied. Second generation seedlings which segregate for certain characters are worthless if damping-off takes the weaker ones.

Previously the soil has been sterilized by chemicals or heat, with varying degrees of success. Where seedlings are germinated every month this method becomes laborious, and considerable time must elapse before the seed can be planted. The sterilized soil becomes infested in a short time so that not more than two lots of seedlings can be grown for each sterilization.

A method has been in use whereby seed is germinated under 200-watt Mazda lamps suspended two feet above the seedlings. A dome reflector concentrates the light and heat so that two hundred seedlings can be grown under one lamp. A mixture of half sand and garden soil is used because it affords good drainage and reduces nitrification. This soil, without the lamps, controls the damping-off if sunlight is not reduced too much and the air does not remain too moist, but the lamps are needed after autumn begins. The seedlings become spindly if a rich garden soil is used.

The lamps are lighted as soon as the seed is planted and are not turned off except on bright sunny days. After the cotyledons have unfolded, the lights may be discontinued if the weather is bright and the surface soil is kept dry. It is preferable, however, to use the lamps until the seedlings are transplanted. With unfavorable growing conditions the potted plants may be exposed to the lamps several hours in the evening until the plants are large enough so that there is no further danger of damping-off.

The lamps have been used to advantage on selections that produce only pistillate flowers during the winter months. These selections may be selfed if the potted seedlings are exposed to the electric light until four or five true leaves are formed. Sufficient staminate flowers will be produced so that the first few pistillate flowers may be self-pollinated. An extra generation can thus be grown for those characters that are not influenced by environment.

Corn and lettuce grown by this method produce sufficient seed for an extra generation. The method has considerable application in northern latitudes where only the vegetative stage of adapted greenhouse plants can be grown during the winter months.

The advantages of the lamps, in addition to controlling damping-off, are that the soil is warmed so that weak or old seed germinates better in a shorter time, and the germinating can be done in a cool greenhouse without increasing the temperature of the greenhouse.

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SPECIAL ARTICLES

CINEMATOGRAPHS OF LIVING DEVELOPING RABBIT-EGGS[1]

RABBITS' eggs of definite ages after mating, $21^2/_3$, 22, $23\frac{1}{2}$, 67, 69 and 71 hours, were washed from

[1] The rabbits for these experiments were supplied by Professor W. E. Castle, of Harvard University.

the tubes with Locke solution, mounted in blood plasma or modified plasma on flat slides with supports under the cover-glass, sealed with paraffin and kept on the microscope stage in a warm box under the camera. Autoplasma and homoplasma were better than chicken plasma. The preparation of the mounts (cutting out the tubes, washing the eggs out with Locke solution at room temperature, picking up the five or six eggs of a litter with a small pipette and mounting each egg separately in plasma) took from one half hour to one hour. During most of this period the eggs were at room temperature, hence their development was probably somewhat delayed. The magnification on the cinematographic film was forty-four diameters. Exposures were made at the rate of two and one half per minute.

Under normal conditions *in vivo* the rabbit's egg segments into two cells at 22 to 25½ hours after mating, into four cells at 25½ to 32 hours, into eight cells at 32 to 41 hours, and into sixteen cells at 41 to 47 hours. The cleft which forms the beginning of the segmentation cavity appears at 68 to 76 hours after mating, and a small cavity develops within an hour or two. The inner cell mass begins to show at about the same time, *viz.,* 70 to 76 hours. The segmentation cavity increases slowly in size, the trophoblast walls become thinner and thinner, and the whole egg also increases slowly in size until about 90 hours after mating when the egg rapidly increases in size and the zona pellucida becomes stretched and thin.

I. Beginning with the One-cell Stage

Several eggs in the one-cell stage were obtained from three animals that were killed 21⅔, 22 and 23½ hours after mating. Those that were followed divided into two cells from one to three hours after they were taken from the tubes, or from 24½ to 24¾ hours after mating. If one hour delay due to cooling be deducted the divisions fall well within the normal period (22 to 25½ hours) after mating. Three of the eggs were in the four-cell stage at 28 to 30 hours after mating and were also well within the normal period of 25½ to 32 hours. Two were in the eight-cell stage at 39 and 42:05 hours after mating. They also indicate that the progress of cell division was about normal.

The cleavage of egg C50–2 which was taken from the tube 23 hours and 30 minutes after mating was as follows: at 24:45 it was in the two-cell stage, at 29:06 in the three-cell stage, and at 29:45 in the four-cell stage, each of the first two blastomeres divided once thus giving rise to two pairs. One cell of the first pair of blastomeres of the four-cell stage divided at 35:50 and the other at 36 hours after mating. One cell of the second pair of the four-cell stage divided at 38 and the other at 39 hours after mating. The eight-cell stage was thus brought about by dichotomous division. There was an interval of about four hours between the two- and the three-cell stage and of one hour between the three- and the four-cell stage. Between the four- and the five-cell stage there was an interval of about six hours. The intervals between the five- and the six-, the six- and the seven-, the seven- and the eight-cell stages were from ten minutes to two hours each, the longest interval occurring between the six- and the seven-cell stages. Are such differences in the time of division significant and do they indicate differences in the cells? The fact that one of the first two blastomeres divided about an hour before the other may indicate that already at the first cleavage a segregation of materials has taken place.

There are other indications that the cells differ from one another. Four eggs in the two-cell stage were cinematographed and in each case the two cells were of unequal size throughout this stage. The cinematographs of two of the eggs show that the largest cell in each egg was the first one to divide. The other two eggs were not recorded. In the four-cell stage the first pair of cells are usually larger than the second pair. In the eight-cell stage the cells of the first quadruplet, that is the four cells derived from the first pair of the four-cell stage and the largest cell of the two-cell stage, are larger than those of the second quadruplet.

During the eight-cell stage of egg C50–2 the cells of the first quadruplet were nearly spherical in form and occupied more than half the space within the zona pellucida. They remained as a distinct group with triangular spaces between them and the zona pellucida. The second quadruplet massed themselves more closely together, lost their spherical forms and as a result the cell limits were not clear. This mass became somewhat flattened out against the zona pellucida.

The cinematographs also reveal a certain amount of shifting of the cells, especially after each division. The movements of the granules within the cells became more pronounced shortly before the cell division. The cells also seem to undergo peculiar pulsations or changes in size.

Some of the eggs that were started in the one-cell stage continued to live for about two days after they were taken from the tubes. We have not yet determined just how far it will be possible to carry them or how much of the growth is normal.

II. BEGINNING WITH THE LATE MORULA STAGE

The eggs taken out from 67 to 71 hours after mating lived for a much longer time than those that started in the one-cell stage. Two 67-hour eggs (C52–1 and C52–2) continued to live and increase in size for about eight days after they were taken from the tubes. Egg C52–2 remained in the morula stage for several hours. The number of cells seemed to increase. At 76 hours and 20 minutes after mating, or 9 hours after removal from the tube, part of its periphery was surrounded by columnar epithelial-like cells with a cleft at one place along their inner border. A small cavity was visible. This is about the normal time for the appearance of the segmentation cavity especially if one hour be deducted for the delay when the egg was at room temperature. During the next hour the extent of the columnar epithelial-like cells, the trophoblast, increased and the segmentation cavity enlarged. The inner cell mass was not in a favorable position for observation. During the next 1½ hours ending at 79 hours after mating the segmentation cavity increased in size and the epithelial-like cells of its walls became cuboidal. During the next two hours the cavity increased still more in size, the trophoblast wall became thin and the entire egg had enlarged somewhat. During the next seven hours the egg continued to expand and the zona pellucida became thin. During this period the egg occasionally contracted rapidly in the course of two or three minutes to more nearly its original size and then slowly expanded again. This phenomenon was probably due to the stretching of the rather tough elastic zona pellucida by the accumulation of fluid under pressure within the segmentation cavity, until a small break occurred sufficient to allow the escape of fluid from the cavity, and as the tension was relieved the zona pellucida contracted down to about its original size. The cells of the trophoblast then apparently healed over the break and the process was repeated again and again. During contraction the thin trophoblast became thicker only to thin out again as the egg expanded. At 98 hours a small cellular hernia was noted. This slowly increased in size as it bulged out through a distinct break in the zona. As the hernia increased in size the tension on the zona pellucida was relieved and it returned to about its original size and thickness.

From now on during the next six days the hernia continued to expand, and reached its greatest extent (.555 mm diameter) about ten days after mating, or between seven and eight days after the egg was taken from the tube. The segmentation cavity was early observed to extend into the hernia or exovate. Its walls consisted partly of thin trophoblast and partly of thicker material, probably the inner cell mass which had apparently also escaped out into the hernia. The old zona pellucida with its lining of thin cells and small segmentation cavity formed a very insignificant part of the whole mass at the end of the period.

During this period of expansion of the hernia there were rapid variations in the size of the sac. An explanation similar to that given for the expansions and contractions of the zona during the earlier stages probably applies here also. Fluid was evidently secreted under pressure into the segmentation cavity by the trophoblast. When the pressure became too great a small break probably occurred and the elastic recoil of the elastic and tense trophoblast cells expelled fluid until an equilibrium was reached. The cells then healed over the break and the expansion began again. The expansions and contractions were revealed by the cinematograph. Such variations would hardly have been discovered as readily by any other method. It was not possible to follow with the eye any differentiation of the inner cell mass and the cinematograph did not help in this respect.

After the eighth day of incubation the egg took on an unhealthy aspect and decreased considerably in size. We are not quite sure just how long it continued to live.

A second egg (C51–1) from the same rabbit was carried along at the same time on a separate mount and filmed at intervals. It behaved very much as did the first egg. The inner cell mass, however, was located in a more favorable position and could be followed until it passed out into the hernia, where it was lost from view. The cells of the inner cell mass of the second egg appeared to be in a constant state of agitation as long as it was visible. The hernial sac did not become quite as large as the first one but the egg continued to live about as long.

Both films showed what appeared to be the ameboid cells, probably endodermal cells migrating about on the inner surface of the thin trophoblast.

Under normal conditions the eggs enter the uterus 72 to 80 hours after mating and soon undergo rapid expansion. In order that the latter may take place it is probable that some of the secretions of the uterus alter the character of the zona pellucida so that the expanding egg can stretch it into a thin membrane without exerting undue tension and producing rupture. Without such a softening of the zona pellucida normal development probably can not take place.

The great advantage of the combination of the

progressive development of the early stages of the living egg and the cinematographic record of the same over any other method is obvious. One has on the film a permanent record that can be examined repeatedly.

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DETECTION OF THE ISOTOPES OF LEAD BY THE BAND SPECTRUM METHOD

A FEW years ago Grebe and Konen[1] found that the lines near 4250 Ångstroms in the band spectrum emitted by an arc containing uranium lead were sharper than those from an ordinary lead arc, and were displaced .055 Ångstrom units towards shorter wave-lengths. A comparison of this nature is of interest, since it furnishes a direct experimental test of the isotope effect in band spectra.[2] In addition, if carried out with high resolving power, the experiment leads directly to a new method for the quantitative analysis of lead of radioactive origin. Such information has an important bearing on the problem of geologic time.[3] Consequently Dr. Mulliken suggested to the writer that he repeat Grebe and Konen's experiment, using improved experimental conditions.

The spectra were photographed in the second order of a twenty-one-foot Rowland grating first using an arc of ordinary lead (atomic weight 207.2), and then repeating with lead of atomic weight 206.1. This uranium lead, mined in the Belgian Congo, was a gift from the Wolcott Gibbs Memorial Laboratory of Harvard University. We are indebted to Dr. L. P. Hall for this material. The arc was struck between molten lead globules stuck to copper rods. The current carried was three amperes and was supplied at 220 volts. The exposure time was about fifteen hours.

A line for line comparison of our spectrograms, for instance, near the head of the strong 5678.3 Å. band where there is comparatively little overlapping of neighboring series, shows that each line in the band spectrum secured using uranium lead (Pb_{206}) corresponds to the long wave-length member of a group of three lines in the spectrum secured using ordinary lead ($Pb_{208,\ 207,\ 206}$ with relative abundance 7, 3, 4 respectively according to Aston's recent positive ray analysis).[4] Figure 1 makes this comparison

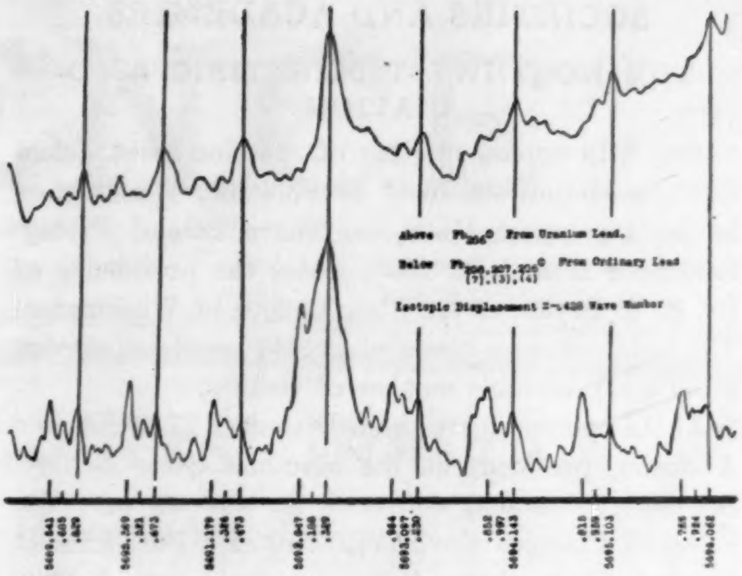

FIG. 1

clear. The upper curve is a microphotometer trace of the spectrum of this region taken with uranium lead in the arc. The lower is the corresponding curve with ordinary lead in the arc. These were secured with the Moll instrument which records automatically. The ordinates represent deflections of the beam of light reflected from the mirror of the galvanometer in the thermopile circuit. The strong peak in the middle of each curve is an arc line of lead and serves as a convenient reference line. The light, vertical lines identify the peaks in both spectra emitted by the molecules containing isotope 206. The series lines which we now find are due to oxides of isotopes 208 and 206 in ordinary lead were measured many years ago by Lamprecht,[5] who designated them by series I and III respectively in his tables of wave-lengths. The intermediate series which we find corresponding to 207 is not represented in Lamprecht's measurements since he used lower dispersion and resolving power than was employed in our experiment.

The results of this investigation are in good agreement with the theory on the basis of PbO as the emitter of these band spectra. The separation to be expected theoretically between the lines due to $Pb_{208}O$ and $Pb_{207}O$ near the head of the γ 5678.3 band is $-.37$ wave number. The average measured value was $-.43$ wave number. The negative sign indicates that the lines from the molecules containing the lighter isotope are displaced towards lower frequencies with respect to the radiations from the molecules containing the heavier isotope. Our method yields an analysis in agreement with that of Aston.

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[1] L. Grebe and H. Konen, *Phys. Zeit.*, 22: 546. 1921.

[2] *Cf.* R. S. Mulliken, *Phys. Rev.*, 25: 119. 1925.

[3] See an excellent summary by Dr. C. S. Piggot, of the Geophysical Laboratory of the Carnegie Institution of Washington, in the *Journal of the Washington Academy of Sciences*, vol. 18, no. 10, May 19, 1928.

[4] F. W. Aston, *Nature*, 120: 224. 1927.

[5] H. Lamprecht, *Zeit. f. Wiss. Phot.*, 10: 16, 33. 1912.

SOCIETIES AND ACADEMIES

THE NORTHWEST SCIENTIFIC ASSOCIATION

THE fifth annual meeting of the Northwest Scientific Association was held at Spokane, Washington, in the Davenport Hotel, on Thursday and Friday, December 27 and 28, 1928, under the presidency of Dr. E. A. Bryan, of the State College of Washington. The meetings were attended by 142 members, as well as by a considerable number of visitors.

At the opening meeting on December 27 Dr. Alfred Atkinson, president of the Montana State College, Bozeman, Montana, delivered an address on "The Effect of Changed Environment upon a Pure Line of Plants." A luncheon of the association was held at noon of the first day at which Major John D. Guthrie, assistant district forester, Portland, Oregon, spoke upon the topic, "The National Forests; their Part in State Development." In the afternoon a general medical session was held, and in the evening at 6:30 members met for the annual dinner in the Elizabethan Rooms of the Davenport Hotel. At this time the address of the retiring president, Mr. L. K. Armstrong, of Spokane, Washington, was given, the subject being "The Northwest Scientific Association: a Vision of the Future." H. V. Carpenter, dean of the school of engineering, State College of Washington, spoke on "The Rising Status of Industrial Research," after which were shown moving pictures of the construction of the Cascade bore on the line of the Great Northern Railway.

A luncheon was held also on the second day of the meeting and an address was delivered by Dr. Francis A. Thomson, president of the State School of Mines, Butte, Montana, on the topic, "The Gold Production of the Early Placers of the Northwest."

In addition to the general sessions section meetings were held on both days by the following groups: Botany-Zoology, Chemistry-Physics, Education-Psychology, Engineering, Forestry, Geology-Geography, Plant Pathology and Social Science.

At the annual business meeting on December 28 in addition to the usual resolutions a resolution was passed in appreciation of the services of the late Dr. J. E. Kirkwood in the development of the association.

A report of a special committee named to redraft by-laws relating to membership was approved by the organization. This report provided for four types of membership in addition to the ordinary membership, namely, institutional memberships, life memberships, supporting memberships and patrons.

The secretary reported that the association had been regularly incorporated under the laws of the state of Washington, with headquarters at Spokane.

The following officers were elected:

President: Dr. John Kostalek, State University, Moscow, Idaho.

Vice-President: Dr. Francis A. Thomson, president, State School of Mines, Butte, Montana.

Secretary-Treasurer: J. W. Hungate, State Normal School, Cheney, Washington.

Councilor (five years): Dr. C. C. Todd, State College of Washington, Pullman, Washington.

Councilor, to fill unexpired term of Dr. Kostalek: Dean Ivan C. Crawford, State University, Moscow, Idaho.

Trustee (three years): Dr. M. A. Brannon, chancellor, University of Montana, Helena, Montana.

J. W. HUNGATE,
Secretary-Treasurer

THE INDIANA ACADEMY OF SCIENCE

THE Indiana Academy of Science held its forty-fourth annual meeting at Indiana University, Bloomington, Indiana, on December 6, 7 and 8, 1928.

The officers in this meeting were as follows:

President, E. G. Mahin, Notre Dame; *vice-president,* Walter N. Hess, Port Clinton, N. Y.; *secretary,* Ray C. Friesner, Indianapolis; *assistant secretary,* W. P. Morgan, Indianapolis; *treasurer,* M. W. Lyon, Jr., South Bend; *editor,* John J. Davis, Lafayette.

The meetings of the academy proper were preceded by the annual informal meeting of the entomologists of Indiana on December 6. At the regular meetings of the academy the number of papers presented in the various sections were as follows: botany, twenty-nine; chemistry and bacteriology, fourteen; geology and geography, nineteen; physics and mathematics, sixteen, and zoology, eighteen.

The annual public address was given by the president of the academy, Dr. E. G. Mahin, professor of analytical chemistry and metallurgy at the University of Notre Dame. Dr. Mahin spoke on "Metals and the Microscope," and illustrated his address with many excellent photomicrographic slides.

The officers elected for the ensuing year were:

President, Louis G. Rettger, Indiana State Normal School, Terre Haute; *vice-president,* J. A. Nieuwland, University of Notre Dame, Notre Dame; *secretary,* Ray C. Friesner, Butler University, Indianapolis; *assistant secretary,* W. P. Morgan, Indiana Central University, Indianapolis; *treasurer,* M. W. Lyon, Jr., South Bend; *editor,* John J. Davis, Purdue University, Lafayette; *press secretary,* Harry F. Dietz, Department of Conservation, Indianapolis.

The next annual meeting will be held at Earlham College, Richmond, Indiana.

HARRY F. DIETZ
Press Secretary

INDIANA ACADEMY OF SCIENCE